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EDITORIAL

Imperial Chemical Industries

A very cheerful announcement has recently been made as to the profits of Imperial Chemical Industries and the dividends for the year 1932. The gross profit for 1932 was £6,415,000 compared with £4,668,000 for 1931 and the net profit for 1932 was £4,729,000 compared with £3,408,000 for 1931. To achieve such an increase in such difficult times as these indicates a very able and prudent course of business not only during the year in question but also during the previous years when the business of the individual companies was being built up on a sound basis. Out of the gross profit £1,000,000 is set aside for obsolescence and £500,000 for general reserve; the carry forward is now £543,770. No one can question the wisdom of such a policy; it is one that has been adopted by the most reputable companies in the world for a long period and has been found to bring them prosperity; companies that have paid more attention to the profits they pay away than to the profits they keep in the business have had terrible shocks during the last few years not only in this country but also in many others. A dividend of 6 per cent. for the year is declared on the ordinary shares; the deferred shares receive no dividend until the ordinary shares receive 7 per cent. That this prudent and sensible policy meets with the general approval of the public is shown by the high price at which the I.C.I. shares now stand. The company has given notice that the wage reductions made in its factories in June, 1931, are to come to an end on April 3, a decision that will be pleasing to the 25,000 workers employed. It is a sign of the times that a company with a capital of about £77,000,000 should employ only 25,000 workers; modern chemical plant is extremely expensive to erect and very cheap to run and the old idea that a company would employ about one worker for every £1000 of capital has long ceased to be in accordance with the facts. No one can yet say that the world as a whole is in a more stable or prosperous or happy condition than it was a year or two years ago and it may well be that in some countries there will be bad times, perhaps even worse times, before there will be good times again. The great improvement shown by the I.C.I. is an indication that the chemical industry of this country has already begun to look up and as the I.C.I. depends for its prosperity on many other industries it may be presumed that these are also doing better. Many other industries would improve if the great continental countries in both hemispheres were less insular; we in this little island have, by a singular train of circumstances, long been inclined to look at industry and commerce from a world point of view as well as from our own point of view. We must not expect the other great nations to alter their policies speedily. That in some respects we are advancing in a sensible way is shown also by the results of the British Industries Fair which we print in this issue. The report of the I.C.I. is a real encouragement to all who reflect on industrial conditions and we sincerely trust that during the current year the company will continue to prosper.

Research by the State

The government of the people by the people for the people is possibly becoming an accomplished fact with greater definiteness and ease in this country than in any other. A model government may be claimed to include research. Though for a long time it was complained that the State as such did nothing to encourage, support, or promote research, yet such is the unreasonableness of man, when the Department of Scientific and Industrial Research was first formed fears were expressed in many quarters that it would do wrong, either by supporting research of too academic a character or what is worse, interfering in industry and undertaking investigations which should properly be left to the industry: in either instance a waste of public money was predicted. Perhaps such views have been of value in enabling a middle course to be steered; at any rate we doubt if even the most optimistic advocate of the Department of Scientific and Industrial Research at its inception would have been prepared to forecast such a success for it or such a record of positive achievement as is set out in the Seventeenth Annual Report. No one knows which laboratory discovery may prove to be of practical importance in that it brings benefit to the community at large; we are prone to over-emphasize

the potential value of every academic discovery, such as that of benzene by Faraday, or his more important one in the worldly sense of magnetic induction. Yet both these had to wait half a century or longer for their practical application, and it would be wrong in the present state of taxation for the State to expend its money on such long shots. On the other hand, the scientific work on the respiration of fruits and changes of state in proteins is having an almost immediate practical value in connexion with the transport of fruit and meat within the Empire; moreover, the cold storage experiments have to be on a scale which is impracticable either for a university or a firm of growers or importers. Hence only the State can carry out the research, and there will be no two opinions as to the measure of success which is attending it. An important question regarding industrial research associations which are in large part financed by the industry is whether parliamentary authority should be sought to raise the necessary funds for them by a compulsory levy on raw material, output, or some other convenient basis of assessment. An enquiry made on this point by the Department of Scientific and Industrial Research has shown that there is a strong opinion unfavourable to the compulsory principle, it being affirmed that if the industry itself does not favour collective research, it is either too soon or too late to help it. Chemists will concur in this point of view; least of all in laboratory research or in its application to practice is State compulsion desirable. If the economic pressure does not supply sufficient compulsion, then the matter is best left alone. This somewhat controversial subject is exemplified in our opinion by the state of the fuel problem, which the Department says is the most crucial problem with which it is faced. The fuel-producing industry is largely unwilling to help, the fuel-using industry is largely indifferent, except to its special interests, whilst in the opinion of some people the Fuel Research Department has failed to grasp the problem as a whole and co-ordinate the work of the isolated interests into an efficient entity: there is too much overlap of the work being done at Greenwich and elsewhere. Research of all kinds is going forward at a rate definitely greater than mere arithmetical progression: more especially is it being directed to finding new uses for old materials. This is a sign both of depressed times and also of the revolution in manufacturing which has made the world no longer content to do things in the old way. Science, the engineer, and the chemist are being urged to find a new way and the call is not being made in vain.

Atomic Disintegration

Lord Rutherford had a great reception on Friday evening (March 10) at the Royal Institution, when he gave the now expected annual account of his bowling score for the year. As a piece of lecture-table histrionics, the performance was superb: unsurpassable in its clear voiced honesty and simplicity of delivery. He makes no bones of aiming straight at the belly of the atom. He thinks that, if he can only get his shot into the atomic locker and make a mess of things, he will be\ able to find out what are the contents. The occasion was the chief of five tests, the other four games having been played on Saturdays, February 18 and 25, March 4 and 11. The bowling has been straight and hard throughout, with the aid given by the modern high vacuum pump; the pace terrific. So that those at a distance could mark the ball, sparks have been struck from a Crookes' spinthariscope screen; the hits scored have been counted "wisibly" and also made audible. Every refinement of the modern game has been brought under notice. It is a game! Not perhaps for gods because we have no particular evidence that gods are either mathematical or imaginative, let alone endowed with fingers and knowledge of radium: but for a strange race of higher laboratory beings soaring in the new empyrean of atomic micro-alchemy. Lord Rutherford claims in the past to have transmuted nitrogen into oxygen and beryllium into carbon, by firing swift α-particles at them from a radium gun. The process pictured involves both knocking off a proton chunk from the atomic armour plate by the helium shell, and the retention of the shell in the plate: the victimized atom loses one unit of mass on the swings but picks up four afresh on the roundabouts:

$$N^{14} + He^{4} = H^{1} + O^{17}$$
$$Be^{9} + He^{4} = H^{1} + C^{12}$$

During the year, in the Cambridge skittle alley Messrs. Cockcroft and Walton have developed a new form of game with hydrogen atoms (protons) moving at very high speeds, generated by a high voltage discharge. Lithium and boron are both supposed to have been transformed into helium under the fire. Arithmetically, on paper, the process is delightfully simple:

$$7 + 1 = 8 = 2 \times 4 \qquad 11 + 1 = 12 = 3 \times 4$$
$$\text{Li} + \text{H} = 2\,\text{He} \qquad \text{B} + \text{H} = 3\,\text{He}$$

Apparently a strange new art is being developed that of heliotry—which may involve either enslavement or freeing of helium. Soon we shall have "chain reactions" even in sub-atomic chemistry. These things, be it said, are thus far happenings in the mind's eye; they have been seen only by an inspired ratiocination and are but daring interpretations of sndry outward and visible signs. Were the guardians of the elements to indict Lord Rutherford for high treason in thus assoiling their majesty, the evidence of guilt is in no way sufficient, at present, to justify his being sent to the block. Still—you never can tell! we must wait and see! Chemists would not be true to their colours, however, if while sitting up and taking such unforeseen nourishment they did not follow the example of Oliver Twist and ask for more—for evidence of product—before bowing the knee to the new Baal. The neoalchemical school is a veritable Light Brigade: fortunately, its great leader has circumspection and remains a modest man. Other forms of attack—by neutron and cosmic particles—were also brought under notice in the lectures. Those who attended have reason to be very grateful: the task of delivery is no slight one. Only one request would we make—that workers in the electronic field should revise their terms and not call a charged ion *negative* and an uncharged one *positive*; in fact, a charge is not a charge when it is positive in their world. When they cry, "steer to starboard but keep her head larboard," what on earth is the helmsman to do?

ALCOHOL THROUGH THE AGES

JUBILEE MEMORIAL LECTURE

By E. F. ARMSTRONG, D.Sc., Ph.D., LL.D., F.R.S.

Though we live in the present and must think for the future, it is still possible to venerate the past. It is of interest, therefore, to select a substance of some antiquity and seek to trace its uses, the facts about it, and its relation to current affairs and knowledge through the ages. Of such substances I know of none more suitable than alcohol, that chemists term ethylalcohol, and I shall seek to show its connexion with the development of chemistry, both pure and applied.

It is impossible within the compass of a lecture, either in the spoken or written word, to cover such a subject completely or even adequately. Hence I must content myself with selecting such sections of the story as have the greatest appeal and significance, and aim at simplicity, at the risk perhaps of omissions, for which I must crave indulgence from the meticulous.

As Virginia Woolf has somewhere said, if we rummage among the fragments of the past we shall at any rate leave the high road and perhaps hear some roar of laughter from a tavern door.

Alcohol, the substance, is best known as the active principle of intoxicating liquors, and the word is almost synonymous with these in their distilled form. But it has other uses and significance. I shall consider it first in pharmacy as a tincture, then in chemistry as a solvent, a reagent for the preparation of ethers and esters, and one of the compounds round which the foundations of the theory of our science was laid. Next it claims attention as a solvent and a vehicle in the industrial arts, and to-day it is produced in very large quantities as a primary raw material of industry for the synthesis of carbon compounds. To-morrow it may serve as a fuel for the internal-combustion engine. As for the future, who knows what may be in store ?

The word " alcohol " is an example of the way in which words come to change their meanings, particularly when they have a long-continued popular use. It is derived from the Arabic Al Koh'l, the fine powder used in the East to stain the eyebrows and eyelashes: it first appeared in the English language in the 16th century. Powdered ore of antimony, stibnite, or antimony trisulphide, sometimes also powdered galena or lead ore were used for this purpose. Francis Bacon in 1626 says " the Turks have a black powder made of a mineral called alcohole which with a fine long pencil they lay under their eyelids." Hence in early chemistry the word alcohol was applied to any fine impalpable powder produced by trituration, or especially by sublimation, as, for example, alcohol of sulphur, meaning flower of brimstone. Sir H. Davy in 1812, in his *Chemical Philosophy*, says " I have already referred to the alcohol of sulphur."

When the idea of sublimation was extended to fluids, the word alcohol came to mean an essence or quintessence or spirit obtained by distillation or rectification, as in the familiar phrase alcohol of wine, meaning essence or spirit of wine. Paracelsus and Libavius both used the term to denote a fine powder, though the former also uses it for a volatile liquid. Alcohol is defined as late as 1773 by Beaumé in his *Chymie Experimentale* as meaning primarily powders of the finest tenuity, and, secondarily, as spirits of wine rectified to the utmost degree.

Phillips in 1706 defines alcohol as the pure substance separated from anything that is more gross. It is more especially taken for a most subtile and highly refined powder, and sometimes for a very pure spirit. Thus the highest rectified spirit of wine is called *Alcohol Vini*. During the 13th and 14th centuries the name *Eau de vie* (Elixir of life) was in use: Villanovanus applied it to the product of distilled wine, though not as a specific name. It was a short step from applying the word to rectified spirit of wine to give it the significance of the spirituous or intoxicating element in fermented liquors, and very soon in popular parlance the term came to cover any liquor containing this spirit.

The association of the word alcohol with potable liquors, and hence with burdensome excise restrictions and regulations, is causing the word " ethanol " to be used increasingly in industrial operations. For the same cogent reason the term " methanol " has almost entirely replaced methylalcohol.

In our systematic organic chemistry the term has a wider meaning, it being the generic name for a class of hydroxyhydrocarbons of which the typical member is ordinary alcohol or, specifically, ethylalcohol. Originally its use was confined to those substances which had qualities more or less analagous to ethylalcohol, but it has been extended to substances derived from a hydrocarbon by the displacement of one or more hydrogen atoms by an equal number of OH groups: it thus includes glycerol, mannitol, phenol, naphthol. The first systematic classification of the alcohols was applied by Kolbe in 1860, who gave them the generic name of carbinols.

ALCOHOL IN THE MIDDLE AGES

The process of distillation was known to the ancients, though the earliest records of its application for obtaining concentrated alcohol for use by the Arabian doctors in medicine date from the 10th century. Distilling became known among the people from about the 15th century onwards. Lippmann (Chem. Zeit., 1913, **37**, 1313) on the other hand considers that alcohol was unknown to the Arabian chemists and that the process of distillation was unknown in Asia. He contends that the discovery of alcohol took place in Italy, and that it was first mentioned in an Italian work of the 9th or 10th century. The researches of Fairley (Analyst, 1905, **30**, 294) suggest that distilled alcoholic beverages were obtained from materials other than wine even before this date, for example, arrack distilled from fermented rice spirit.

One of the first authors to describe intelligently the concentration of alcohol by distillation was Albertus Magnus. Born in 1193, he was a contemporary of Roger Bacon—as chemists we revere him as being the first to use the word " alkali," which he prepared from wood ashes and lime. He also was one of the first to use the word " vitriol " as applied to the sulphates of the metals.

Distilling is said to be first mentioned in the English tongue in a translation by a Fellow of Magdalen College,

Oxford, of the *Treasures of Evonymus*, wherein it states "Distillation is the drawing forth of a thinner and purer humor out of a juice by the force of heat."

From an old book entitled *The Laboratory*, published in London in 1756, which contains an article on the art of distilling, translated from the High Dutch, one may gather that "distilling is an art by which the principals of a mixt body are drawn off into proper vessels by means of fire or heat. To draw off spirits is to cause them, by working, to be disengaged from such bodies wherein they are detained. Is warmth the property of a body, and facilities the separation without any foreign aid, it is called a fermentation. Is the separation caused by fire, or any other warmth, whereon the limbeck* is placed from without, it is called digestion or distillation. Distillation is when the fermentation is so powerful that the spirits thereby are separated, ascend, and fall down again in drops. If we set about distilling in a common limbeck we must be careful in cleaning it thoroughly . . . and then you put in the ingredients you intend to distill; you ought to use the same care in cleaning and drying the helm of your limbeck. This being done, you close the two parts of your limbeck carefully together, with damp brown paper and lute, which is a compound paste of wood ashes, finely sifted and tempered with water: some make use of clay, others of a paste boiled with flour or starch."

There follow directions for the distilling of brandy from wine, from a fermented mash of grain. We quote again as follows.

"As the rectifying of spirits requires a great precaution, it will be proper to have the management briefly explained. It has already been said that the rectifying of spirits is nothing else but repeating the distilling of the same. The first method to do this, is when the spirit of wine is brought over, you draw off the remains out of the limbeck, and pour the distilled liquid into it, with which you proceed in the same manner as before, and bring about half of it over the helm again. You then make trial by burning a little of the liquid in a spoon: this done, you judge, from the remaining water, how far your spirit of wine is rectified. In case you find it has not arrived to its perfection, you repeat distilling it once or twice more, in the aforesaid manner, till you find it arrived to the desired degree. The rectifying of spirits is the most dangerous operation in distilling of spirituous liquids, and requires therefore great care in frequently cooling the helm, so as to prevent the imminent danger the neglect of it would produce. In this manner, rectified spirits of wine is very clear, and is commonly made use of for cordials and odoriferous waters. The quickest way, and which generally is made use of, is to rectify the same over an open fire, but it is the most dangerous. The best, but the most tedious, is rectifying it thro' the serpentine cooler. The least dangerous is the method of doing it in *Balneo Mariae*. If you will give the spirit of wine the highest degree of perfection, you must set it in a close vessel on a sand-heat. This is all we are to take notice of concerning rectifying of spirits. The proofs which are made on rectified spirits are of various kind: some judge it by the smell, others with rubbing it between the palms of their hands, which turn dry immediately if the spirit is well rectified; others, again, dip cotton-wool, or paper, into it, and light it by a candle. In case the fire of the spirit burns the cotton, or paper, it is a sign of its perfection, but if on the contrary they take no fire, they conclude it has much phlegm."

Tinctures† or alcoholic preparations of drugs were first introduced into pharmacy by Lully. Of *aqua vitæ* he wrote, "The taste of it excelled all other tastes, and the smell all other smells." Anticipating the soldiers' rum ration of the present day, he says it is "of marvellous use a little before the joining in battle to encourage the soldiers' minds." He prepared the concentrated spirit by repeated distillation, and also by dehydration with fused potashes. Raymond Lully, a native of Majorca, was born in 1235; he studied first medicine and then alchemy. Before the discovery of alcohol wine, beer or vinegar were used to extract the virtues of the drugs.

Only a few organic preparations were known in the alchemistic age, spirit of wine being the chief. It was termed *aqua vitæ* because of its importance to medicine and alchemy, the term alcohol being first met with at the end of the 16th century in the *Alchymia* of Andreas Libavius, published in 1597.

Libavius, born in Halle, died in 1616, was the first chemist of note in Germany who stood up against the excesses of Paracelsus. He wrote an important text book of chemistry in 1595. It is worthy of note that be made a vigorous effort to establish chemical laboratories in which to carry out scientific work. He lived for some years at Rothenburg on the Tauber. He was a specialist in the crude methods of analysis of his day, and originated stannous chloride solution, long known as *Spiritus Fumans Libavii*.

Various chemical transformations of alcohol were well known at the end of the Middle Ages, for example, that into ether produced by the action of sulphuric acid. It is remarkable that alcohol was supposed by the older chemists to pre-exist in unfermented materials, its production during the process of fermentation being unknown at this time. A later school thought that wine contained two principles, characterized as containing (1) much hydrogen, and (2) very little carbon, and that during distillation these combined to form alcohol. In 1806 an advance was made by Fourcroy (*Philosophie Chimique*), who regarded alcohol as a "simpler term," derived from sugar by fermentation.

There were many speculations in the 17th century in answer to the question, What is alcohol? Stahl (1660—1734), who propounded the idea of a physical movement or vibration during fermentation, regarded it as a very light attenuated oil, united by an acid to a larger quantity of water. Kunckel (1630—1703) gave reasons to the contrary: alcohol mixes with water, it does not form a soap with alkali. Junker thought it

* Limbeck is now archaic. It equals alembic, an apparatus formerly used in distilling. Lembick and limbeck were usual in the 15th to 17th centuries.

† In pharmacy a tincture is a fluid solution of the essential properties of some substance, the menstruum being either alcohol ether or ammonia. They are obtained by macerating or percolating crude drugs with alcohol. When a tincture is evaporated it becomes an extract. The B.P. contains to-day a long list of such tinctures.

consisted of phlogiston united with water, since only water was produced when alcohol was burnt, a fact confirmed by Boerhaave (1757).

The qualitative composition of alcohol was first ascertained by Lavoisier in 1781, who found that a pound of spirit yielded on combustion quantities of carbon and inflammable gas (hydrogen), together with water, equivalent to 51·85% of carbon and 13·36% of hydrogen according to modern methods of calculating. De Saussure a few years later was able to work with a much more aqueous product, and deduced the composition to be

	%
Carbon	57·57
Hydrogen	13·96
Oxygen	28·47

These figures, as we know to-day, though less accurate than Lavoisier's, are more complete in respect of oxygen.

The chemical synthesis of alcohol is often attributed to Berthelot in 1854, who obtained it by absorbing a gas containing olefines (ethylene) in sulphuric acid, diluting the product and distilling it.

Actually the credit belongs to our own countryman, Henry Hennell, who in 1827—28, in a paper published in the *Philosophical Transactions*, described the preparation of sulphovinic acid and its decomposition by water to sulphuric acid and water. Meldola in this connexion claims, and in our opinion rightly so, a place for Hennell not inferior to that of Wöhler, who effected the synthesis of urea in 1828. He failed, it is said, to achieve notoriety at the time because alcohol was not regarded as a vital product.

It was Edward Frankland who showed how alcohol could be derived from and converted into ethane. He commenced work at Greenwood College, Hants, in the winter of 1847, " with the object of isolating and identifying the proximate constituents or radicals of which organic compounds are constructed." Like his colleague, Kolbe, he had become disgusted with the monotony of analysing clays at the Jermyn Street Museum, and turned to a subject of greater theoretical interest. The work was continued at Marburg and Giessen. His formulæ CH_3 for methyl and C_2H_5 for ethyl were objected to by Hofmann, who contended they ought to be doubled.

The statement attributed to Pliny: " If anyone will take the trouble duly to consider the matter he will find that on no one subject is the industry of man kept more constantly on the alert than upon the making of wine "—and, let us add, " and beer "—is as applicable to-day as when it was written. Wine is a beverage obtained from the juice of grapes by fermentation. The vine is older than all history, and indeed older than man himself, as proved by fossil remains of it in tertiary deposits.

The brewing industry in its beginnings was a home industry, like the baking of bread; to-day it has developed to a state of high technical efficiency. The researches promoted in connexion with it have materially advanced chemical knowledge.

The art of brewing is of great antiquity. Egyptologists have discovered inscriptions of Egyptian life which show that beer was popular on the banks of the Nile about 1300 B.C. The Egyptians also had wine and date wine. A beverage made from barley is mentioned by Herodotus and by Pliny, though it was despised by the Greeks and Romans as a barbarian drink. According to Tacitus, beer was the usual drink of the Germans. An intoxicating beverage made from cereals of various kinds was known in very ancient times in China, Japan, Russia, and among the natives of Africa. According to Elton's " Origins of English History," Pytheas, about two centuries before Christ, seems to refer to a kind of mead in use in Britain and other Northern countries. Roman historians, at the time of the invasion of Britain, mention that the Britons brewed a kind of ale from barley and wheat. The word " beer " comes from the Anglo-Saxon " bëor," and the word " ale " from Anglo-Saxon " eaul." Hops were introduced from Holland about 1524.

In the British Isles the first spirit of native origin seems to be the " usquebagh " of Ireland, which may have been introduced into Scotland in the 12th century. In the South of England *aqua vitæ* produced by distillation of wine, was imported from France or Spain, and favoured in preference to whiskey.

The primary use of alcohol in the Middle Ages was as a medicine, and it was therefore first manufactured in this country by the monks, who acted both as spiritual and medical advisers to the people. By the 18th century the monastic production of spirit had become general. After the Dissolution the monks set up private distilleries, which so cut into the demand for imported spirit that the foreigners raised the price of the raw material. All sorts of fermented materials were then used in England, and the whole industry fell into disorganization until the formation of the Distillers' Guild in 1638.

I cannot forbear to make some reference to the use of alcohol in the household, having in mind not the attenuated kitchen and its accessories of to-day but that of one hundred and fifty years ago, when housekeeping was an art unto itself and still-room and closet were words to conjure with. I am aided in such reference by the temporary possession of a Receipt-Book of the eighteenth century, which has inscribed in it by some great-grandfather of our present generation: " To my beloved Wife for making such another woman as whom, no receipt can be given," a dedication which suffices to show the importance of the housekeeper's office. Herein is described the art of distilling in general, for these were the days before the spread of education and the consequent ignorance of all the trivialities of every-day life, together with such matters as the simple rectification of low wines into alcohol or spirit of wine and what are called proof goods.

It is explained that " all distilled ardent spirits, from whatever fermented liquor originally distilled, when highly rectified, and rendered pure and free from every other substance, except that proportion of phlegm or water which can never be separated, are absolutely alike in their qualities, and of the same identical nature. When, therefore, brandy properly so called was the only distilled spirit in common use, the rectified spirit employed by chemists and apothecaries, as well as in various other arts and trades, was solely obtained from that source, by a higher degree of rectification, or

re-distilling, and sold under the name of spirit of wine; and, indeed, this alcohol was, in truth, at that time, a spirit actually extracted from wine. On the discovery that a much cheaper distilled spirit was procurable from malt, its low price occasioned it to be soon substituted for brandy in procuring a rectified spirit, or alcohol, which was experienced to be so much the same as that afforded by brandy and denominated spirit of wine, having a real as well apparent sameness of nature, that it occupied its name as well as its office, and became generally used, for medicinal and other purposes, under the appellation of spirit of wine."

There is described also the art of rectifying, flavouring, and colouring proof spirit for the successful imitation of French brandy and the manufacture of British molasses spirit. As analysts we cannot help being interested in the manner in which rum and brandy were made up or sophisticated on their arrival in this kingdom.

"It being customary," says Dr. Shannon, "for dealers in spirits to purchase fifty or a hundred puncheons of rum from the importers at once; part of which is bonded, and the remainder taken home—this being supposed to be on the arrival of the Jamaica fleet, and landing of new rums—it is usual to acquaint their correspondents therewith, and the price they then bear, advising them to lay in their stock against next season: by which means, together with the application and industry of a rider, orders for many casks are obtained. Ten puncheons of Jamaica rum, landed at the Custom House quay, and gauged, are found to contain, for example, a thousand and eighty-one gallons, with a hundred and nineteen over proof. Preparation being made for their reception, they are carted home, and started into a back; which is a vessel of large dimensions, properly gauged and inched, which will contain from five hundred to two thousand gallons. The over proof is reduced, by the addition of a hundred and nineteen gallons of water; and the inch taken, which gives one thousand two hundred gallons: and to this are added four hundred gallons of British spirit made from molasses. These two quantities, put together, make one thousand six hundred gallons; which, divided by four, gives four hundred. So, here is one part in four that is not rum. When molasses spirits cannot be had, they have recourse to the clear rectified malt spirits, which are not so good a flavour. The aforesaid practice is used in all brandies, as well as in rum: the difference only is, that they are more careful to use molasses spirit in brandy, and not malt; it being easier to discover deception in brandy than in rum." These were long before the days of whiskey.

With an ear to the old phraseology of our craft, I take the liberty of a final quotation. "Brandy, or the spirituous part of wine obtained by a first distillation, being usually clogged with more or less of phlegm, and some oleose particles which communicate colour, it is to be disengaged from these foreign intruders by means of repeated distillations; which render it whiter, more light, more fragrant, and far more inflammable."

It is with regret that we leave our old book for more mundane matters.

It forms no part of my subject to discuss such polemical subject as the effects of alcohol on man I cannot subscribe myself as a supporter of the sen ment expressed in the Victorian drawing-room ballad:

> "Lips that touch liquor
> Shall never touch mine."

Rather am I in sympathy with Sir Thomas Horde who has emphasized that "in most of the statemen made with regard to the effects of alcoholic beverag upon human beings, whether in health or in diseas the psychological factor was entirely omitted. A willi and a happy worker would get more work done, and c it better, than an unwilling and discontented worke It is in this direction that alcoholic beverages like be make their chief contribution to economic efficienc Merely to live, or even to live long, is not the thing th matters. What matters is that we live fully, usefull and happily. And if the level of our life is raised these respects by the use of alcoholic beverages, the we are justified in following the instincts of our for fathers."

The State Control of Alcohol

Spirit duties were first introduced by Parliament i order to raise money to help them to fight Charles I an an Excise Department was established in 1643. A litt later a differentiation was made between spirits o account of their strength and origin: only the faculti of taste and smell were relied on to indicate whether spirit was perfectly made and liable to the higher rat of duty. From that date onwards the excise control c distilleries has become increasingly stringent, and mor and more accurate methods of determining alcoholi strength have been introduced.

Inflammability was the first test to be used. A littl gunpowder was soaked with the spirit and a flam applied; if it burned steadily the spirit was regarde as of proof quality. When burning was impossible th spirit was under proof; if it took place with violenc the spirit was over proof. The term "proof" i directly connected with the expression "proving" o testing the spirit.

Methods based on the specific gravity of mixtures c alcohol and water led to the invention of Clarke's hydro meter, the use of which was legalized by the Act c 1787. This Act also led to the Royal Society under taking to determine "the best means of ascertaining th just proportion of duty to be paid by any kind of spirit uous liquor that should come before the officers o Excise." The necessary practical work was under taken by the Secretary of the Society, Sir Charle Blagden, and Mr. George Gilpin, Clerk to the Society their experimental work being ultimately collected i the form of tables, which have proved to be of remark able accuracy. They were largely accepted by Si Edward Thorpe when, as Principal of the Governmen Laboratory, he compiled new British alcohol tables i 1901—8, subsequently legalized in 1915.

* A very full and authoritative review of the knowledg respecting the action of alcohol on the human organization wa prepared by a committee of medical men for the Central Liquo Control Board in 1918 and published by H.M. Stationery Office.

Arising out of Blagden and Gilpin's work is their recommendation of the use of the hydrometer: this led to the adoption of Sikes's instrument and system in 1803, legalized in 1816. The evolution of this instrument was closely linked with the definition of "proof" alcohol. Bartholomew Sikes was a member of the Excise Department, who had for many years made a close study of this subject and was regarded as an authority on it. He left a number of manuscript note-books behind him.*

Legally, proof spirit, as defined in the Spirits Act of 1816, is that of the strength denoted as proof by Sikes's hydrometer or that which at 51° F. weighs exactly 12/13th parts of an equal measure of water. This definition entirely ignored the percentage composition of the mixture, and it was not until 1847 that the relative proportions of absolute alcohol and water were determined by Joseph Drinkwater. His values were:

	Percentage by weight
Alcohol	49·24
Water	50·76

This figure was subsequently corrected by Sir Edward Thorpe to 49·28% of alcohol. The proof standard was criticized by a Royal Society Committee in 1833, but their suggestion to alter slightly the definition of proof spirit was not adopted by the State and the standard laid down in 1816 remains in force at the present time. It is a striking commentary on the accuracy of the earlier work and the conservatism of the Excise Department—in this case a proper one, in my opinion—that a standard laid down over one hundred years ago should still persist.

Denatured Alcohol

This country was one of the first to allow the use of suitably denatured alcohol free of duty. A mixture with 10% of wood naphtha, termed methylated spirits, was legalized in 1855, at first for manufacturing purposes only. From 1861 until 1891 it could be used for any purpose other than consumption as a beverage or a medicine. In 1891 its use was restricted once more to manufacturing purposes, whilst a new methylated spirit containing in addition 0·375% of mineral naphtha was legalized.

In 1906 the ordinary methylated spirit was made cheaper and purer by the reduction of the wood naphtha to 5% and by the granting of a rebate, amounting to 5d. per proof gallon of spirits methylated, to compensate for the increased cost of production due to Excise supervision. Meanwhile, in 1902 it was enacted in Section 8 of the Finance Act that alcohol may be sanctioned for use free of duty after being subjected to some special process of denaturing more appropriate to the particular industry in cases where methylated spirit is unsuitable or detrimental.†

Obviously, alcohol can only be used as a raw material in chemical manufacture when it is exempted from duty, and as the Government necessarily insists always on its being made non-potable or earmarked in some way, it is necessary to find denaturants which will not affect or injure the subsequent chemical process. This particularly applies to those processes in which delicate catalysts are used which would be harmed by any added substances. Fortunately, these regulations have always been interpreted in a very broadminded fashion, and the Government advisers have had a full understanding and appreciation of the difficulties involved, so that for responsible manufacturers there has been no barrier placed in the way of the use of suitable denaturants.

In the U.S.A. the first denatured alcohol law was passed in 1907. There are two classes, one being the so-called completely denatured alcohol, which may be sold freely without restriction or regulation by the Government. The other class comprises the specially denatured alcohols, which can only be used for a specific purpose under a permit. There is a lengthy authorized list of these, in which frequent changes have been made. The question of denaturing is naturally linked up with the prohibition laws, but there is no let or hindrance to the chemical industries based on alcohol, which have assumed very large proportions.

The operation of methylation in England is carried out by an organization which is separate from the distillers who make the alcohol.

The Manufacture of Industrial Alcohol

The many large uses for industrial alcohol to-day are conditional on its cheapness, consequently the processes for making it must be based on cheap raw materials available in large quantity and cheaply transported to the alcohol factory. Fermentation processes still hold the field, but they are menaced in the near future, if not to-day, by the probability of making ethanol from ethylene.

In the United States cane sugar molasses is the chief source; Germany uses potatoes, France sugar beets. At one time corn (maize) was largely used in America. Various tropical and subtropical carbohydrate materials have been suggested or tried, but in most cases the cost of collection has rendered them uneconomic. After all, in the sugar cane, nature, or more accurately the sun, has found the ideal way of transforming its energy into carbohydrate, and it will be hard to beat this as a source of ethanol. Two other industrial sources must receive mention, namely, sawdust and wood waste generally, and the sulphite liquor of the wood pulp industry. But first the production from black strap molasses must be outlined as it is from this material that by far the greater bulk of the world's ethanol is produced to-day.

The molasses is collected from the sugar mills in Cuba, Porto Rico, Java, and indeed everywhere in the world where there is practicable transport to the sea, a huge organization, the United Molasses Company, having been built up for this purpose. The molasses, brought to the seaboard in tank cars, is stored in tanks and shipped in tank steamers to the fermenting plants, which are located adjacent to the coast in both continents. The contents of the steamer are pumped into

* I am chiefly indebted to "Alcoholometry," by F. H. Tate, in collaboration with G. H. Gabb, published by H.M. Stationery Office, 1930, which contains a very full account of the subject for the information in this brief abstract.

† It is unnecessary to describe these spirits in detail. A full account of them will be found in "Alcohol," by Charles Simmonds, 1919.

large storage tanks, and from these into the fermenting vats. Indeed, the molasses, which contains about 50% of sugar, is being handled in bulk like mineral oil from the point of its production to that of its utilization.

The operations comprised in the fermentation have quite recently been described by Eyre (Streatfeild Memorial Lecture, Institute of Chemistry). A pure culture yeast, specially adapted for use in molasses wort of high concentration, is used, to the preparation of which a great deal of care is devoted. Nutritive materials, such as phosphates and ammonium sulphate, are added in proper proportion, and the fermentation is conducted under proper and constant conditions of acidity. By placing the whole fermentation under rigid control, the development of infection is largely combated. A modern addendum to the fermentation process is the recovery and purification of the carbon dioxide produced during the period of brisk fermentation, which is sold either compressed in cylinders or converted into solid or dry ice to give it its American name, or Cardice or Drikold as it is called in this country. The use of this is assuming very large proportions in America, and it is likely to increase still further as the advantages of refrigeration in the transport, storage, and serving of foodstuffs become more fully realized. The final product is alcohol of 96% by volume in a yield of approximately 0·4 of a gallon for every gallon of molasses. The by-products are 2·75 lb. of carbon dioxide and a little fusel oil, said to be 0·3% of the alcohol production. Probably some 150 000 tons of molasses are fermented annually in this country; but it is worthy of comment that but for the greater latitude in the use of denaturants for spirit for industrial purposes this industry would not have arisen.

The preparation of a dextrose molasses from sawdust and its fermentation to ethanol present no great difficulty in the laboratory, but the problem is much more complex in its economic aspects. The process has been carried out more than once on a factory scale, as, for example, by Ewen and Tomlinson up to 1913 in America and our knowledge of it has been brought up to date in a paper by Auden and Joshua in our JOURNAL (J.S.C.I., 1932, **51**, 11 T). After an elaborate study of a number of methods of effecting hydrolysis on the semi-large scale, they found that the best results were obtained on using 1 or 2 parts of sulphuric acid per 1000 parts of liquor, a temperature of 175° and a pressure of 10 atmospheres. Soft wood sawdust was placed in two percolators in series and only a few minutes was required to complete the hydrolysis, 40 to 50% being converted to a mixture of hexose and pentose sugars, or, expressed as fermentable sugar, 30—35%. The acid required works out as 3% of the weight of the dry wood and 3% sugar solutions were obtained. A good deal of expert chemical engineering is required, but the process is regarded as technically solved. Others have developed the use of hydrochloric acid in specially devised acid-proof apparatus. When the price of molasses reached a high level in 1927—29 the potentialities of the sawdust process appeared considerable, but the subsequent fall in molasses has entirely altered the picture. Another difficulty is that of collecting enough sawdust in any one spot to furnish regular shiploads.

More economic perhaps in some countries is the manufacture of alcohol from the waste liquors of the sulphite process for the production of paper from wood pulp. Some 15 million litres were manufactured in this way in 1930 in Sweden, about half of it being used as a motor fuel after mixing with petrol. Some 50% of the wood pulp is recovered as paper, the rest passes into solution, which contains about 2% of fermentable sugars. After suitable treatment to purify it, the sulphite liquor is fermented in the ordinary way. The spirit contains an appreciable quantity of methyl-alcohol. The economics of the process have been discussed by Johnsen (J.S.C.I., 1918, **37**, 129 T) and by Breckler (J. Ind. Eng. Chem., 1917, **9**, 612).

The Manufacture of Alcohol from Ethylene

The synthesis of alcohols from olefines by the addition of the elements of water is a well-known laboratory process. On the industrial scale it is receiving close attention as a possible alternative to the production of alcohol by fermentation.

The manufacture of ethylalcohol from ethylene

$$CH_2:CH_2 + H_2O = CH_3{\cdot}CH_2{\cdot}OH$$

on an economic basis depends on (1) obtaining pure ethylene in quantity at a suitable price; (2) perfecting an efficient method for the conversion.

Ethylene is present in town gas to the extent of about ½% and in coke-oven gas to about 1—2%. Some low-temperature carbonization processes yield a gas containing as much as 4 or 5%. The best source of ethylene is the gas resulting when petroleum is cracked, particularly from those processes carried out in the vapour phase. Such gases are to-day called "cracker gases." It must be remembered that the production of much gas during cracking is uneconomic and has to be avoided: indeed, the more recent improvements in high-pressure cracking technique which enable the requisite heat to be given to the oil with a low temperature gradient—that is to say, the source of heat is only a little hotter than that required by the oil—have resulted in higher yields of petrol and very much less cracker gas. Formerly the oil was circulated through a hot flame several hundred degrees higher than the cracking temperature. The discovery that cracker gas has a value above its fuel value at the cracking plant, either as a supplement to town's gas or its chemical constituents, gave some impetus to vapour phase cracking.

A. D. Little has suggested that it might pay a gas works to install a cracking plant, run so as to give the maximum yield of cracker gas, which he states to be about 25%. The cracker gas would be used to enrich water gas up to the level of town's gas and the anti-knock spirit sold for automobiles. In winter the plant might be run to give the maximum and in summer the minimum yield of gas. We may yet see such plants in this country associated, not with petroleum crude, but with tar from high- or low-temperature carbonization.

The vapour phase cracking process which gives most gas is that known as the Gyro. The composition of the gases obtained in America with it is stated to include 53% unsaturated, of which 54% is ethylene, equivalent

to 28% in the gas. The balance of the unsaturated contains 28% of propylene and 9% of butylene, which can be again cracked to give ethylene in fair yields. It is believed that 40% of the gyro gases can be recovered as ethylene. Ethylene is extracted from the mixture of gases by fractional cooling under pressure. An estimate of the cost of liquid ethylene produced in this way is said to be ½d. to ¾d. per lb.

It should be noted that whereas abundant ethylene is available in the United States, there is little or none produced at present in this way in Great Britain.

The conversion of ethylene into alcohol has been for some time carried ont by the Cie de Bethune at its coke oven works in the Pas-de-Calais. This process has been described in *Chimie et Industrie* (1923, **9**, 664; 1925, **13**, 718). The reactions are

$$C_2H_4 + H_2SO_4 = C_2H_5 \cdot HSO_4$$
$$C_2H_5 \cdot HSO_4 + H_2O = C_2H_5OH + H_2SO_4$$

The gas is concentrated until it contains 20% of ethyleue and passed under pressure into a mixture of 50% of 98% H_2SO_4 and 50% ethyl sulphuric acid at 50° C. The ethylsulphuric acid produced is saponified by steam, the excess acid, now of 50% strength, passes to the synthetic ammonia plant, so that the cost of reconcentrating it is eliminated. The alcohol contains 7—8% of ether; the yield of pure alcohol recovered is of the order of 6 to 10 litres per ton of coal. During the year 1929—30, 1248 tons were produced in this way.

The same process is worked on a much larger scale in America by the Carbide & Carbon Co., which has, however, disclosed no information relating to the process or to the economic results. It is understood some 4 million gallons have been produced up to the end of 1931. Statements as to the cost of conversion vary considerably: it is probable that alcohol was produced from ethylene at a cost of 1s. per gallon.

For a time alcohol was produced in Germany on a small scale from acetylene made from carbide, but this manufacture was abandoned in 1931. Aldehyde was at first produced and then reduced to alcohol. In all only 1,364,000 gallons (62,000 hectolitres) were thus manufactured.

It is obvious from the patent literatnre that work on the conversion of ethylene to alcohol is being actively prosecuted in a number of centres. In addition to improving the technique of the sulphuric acid process by the addition of catalysts, it is sought also to effect the direct hydration of the olefine in the presence of certain catalysts, with or without increased pressure.

In the original process of absorption of ethylene in strong sulphuric acid, the reaction mixture had to be diluted before the ethylalcohol could be distilled off and the dilute acid reconcentrated, this being the major expense of the process, which moreover involves a series of operations carried out in different plant. A good deal of ether is formed at the same time. All these disadvantages render the process uneconomical, except when, as at Bethune, the reconcentration of the acid can be avoided.

An improvement was made when it was found possible to use 70% sulphuric acid and ethylene under a pressure of 50 atmospheres and a temperature about 100° C. (B.P., 1931, 460,492). Reconcentration of the acid back to 70% strength is more nearly a commercial proposition. A much better method is to pass the ethylene in admixture with suitable proportions of steam over the surface of a suitable sulphuric acid catalyst under suitable conditions of temperature and pressure. The acid may be of 60% or less in strength, the concentration on the carrier (pumice) depending on the partial pressure of the steam used and the temperature of the catalyst chamber. Under set conditions of temperature and pressure the acid concentration remains constant, as also its catalytic activity, for an indefinite period. A good deal of work has been done to establish the most suitable temperature and pressure conditions in relation to the strength of the acid. The production of ether may be kept down by using an excess of steam (B.P., 1931, 368,051). Certain acid sulphates may be substituted for sulphuric acid, and the activity of the sulphuric acid catalyst is increased by the addition of promoters, such as silver sulphate.

The production of ethylalcohol from water gas, *i.e.*, from carbon monoxide and hydrogen, is a further possibility. It is well known that with certain catalysts and under prescribed conditions these gases yield almost pure methanol, which is now made by high pressure synthesis in this manner. Under other conditions the German industrialists obtained a complex mixture of methanol and high alcohols, and other substances, but containing little or no ethanol.

Prof. G. T. Morgan (Proc. Roy. Soc., 1931, **A, 131,** 553), who has definitely essayed to increase the proportion of ethanol, has had considerable success when using a catalyst consisting of cobalt nitrate and zinc permanganate, at 400° C. under 200 atmospheres pressure. Such a synthesis, however, does not at present come within the range of economic possibilities. It is beyond our scope to indicate the progress in the conversion of the higher olefines into isopropyl and isobutyl and its isomeric butylalcohols: the subject was partly treated by Dr. Little in his presidential address to the Society at Manchester.

(To be continued)

BRITISH INDUSTRIES FAIR, 1933

The British Industries Fair of 1933, held from February 20 to March 3, was without doubt a commercial success.

All three sections—the lighter industries at Olympia, textiles and furniture at the White City, and the heavy industries at Birmingham—were larger and more varied in 1933 than in any previous year. There was general agreement among exhibitors that in all respects the 1933 Fair had fully come up to their expectations, and in some instances had exceeded them.

To achieve such results at a period when world trade is hampered beyond measure by the financial and political difficulties in which so many countries are involved, is a feat on the part of all those concerned, both exhibitors and organizers, in every section of the Fair. This success moreover, has a value which goes beyond the momentary circumstances. It shows the more plainly from its achievement at a time so unfavourable

for industry and trade as a whole, that as a means of development for both a soundly organized and well-advertized Fair has a firm place in the modern commercial system. The number of Continental fairs, several of them of modern origin, which are held annually, shows that this belief is widely held. Accordingly it is good to know that the British Industries Fair holds a foremost place among those that make their appeal to a world-wide circle of buyers.

Lt.-Col. J. Colville, M.P., Secretary of the Department of Overseas Trade, summed up the official view of the results achieved in the following statement which was issued from London on the closing day: "There has been a distinctly happy atmosphere in all sections of the Fair at Olympia, the White City, and Birmingham. Oversea inquiries have been numerous and many useful orders have been placed, although world conditions have tended to make these not so widespread as at the 1932 Fair. In a great measure these good results are due to the gracious interest of the Royal Family and the whole-hearted support of the Press. There is no doubt that once again the Fair has achieved its object as a great marketing centre for British goods." Exhibitors stated that although foreign buyers were somewhat fewer in 1933 than in 1932 they were "more serious" and ordered more readily—an encouraging sign in view of the many obstacles to international trade. In all, representatives from some 78 overseas countries and territories visited the 1933 Fair. The visitors included important organized delegations from the Argentine, Denmark, Finland, France, Norway, Sweden, and Yugoslavia. Without exception, statements issued to the Press by all overseas visitors expressed the highest admiration for exhibits shown at the Fair. A number of overseas visitors stated that they had seen at the Fair many products which they did not even know were made in Great Britain.

The Chemical Section was housed this year in the main hall at Olympia. It is understood that the majority of the exhibitors feel that this was a great improvement. Nevertheless, to be fully representative of the industry, an expansion of the Section is very desirable, and it is hoped that in future a great many more firms will co-operate in order that the exhibit may eventually be really representative of the whole of the British chemical industry. Most firms report that business is on a level with last year or perhaps in some cases a trifle lower. Actually most firms in the Chemical Section do not expect to obtain many definite orders from new sources but judge the success of the Fair by the number of inquiries. These have this year been fully equal to expectations.

BRITAIN'S COAL PROBLEMS

A meeting representative of many interests in South Wales was addressed by Prof. W. A. Bone, F.R.S., on March 3, on "Britain's Coal Problems." The lecture was held in the New Lecture Theatre of the University College, Cardiff, under the auspices of the College Chemical and Physical Society, the President of the Society, Dr. W. Cule Davies, being in the chair.

Prof. Bone began by pointing out Britain's dependence on coal and the importance of coal exports in the maintenance of overseas trade. Our coal problems vary with time and circumstance. For example, 50 years ago it was questioned whether coal export should be curtailed, our coal being a diminishing asset, whereas to-day the problem is to expand it as much as possible. Coal-owners and miners wish for increased coal consumption, but manufacturers and consumers seek fuel economy. Many regard the chief problem as being the repulsion of the inroad of oil upon the domain of coal, whilst others think that the liberation of the coal trade from political interference is essential for its recovery—the science of coal is being drowned by its politics.

The pre-war expansion of the world's coal demands were completely arrested between 1913 and 1929, which period was followed by the slump of 1930—1932. Exports and internal consumption fell as the following statistics show:

	1913	1929	1932
	Million tons		
Total output	287·5	258	209·2
Total export (including coke)	76·6	64·4	41·9
Bunkers	21·1	16·4	14·2
Home consumption	190	177	150·1

These figures by no means represent the extent of the real setback to the coal trade since 1913, because had our 50 pre-war years steady rate of increase in coal output been maintained, by 1932 it should have been no less than 427,000,000 tons per annum. The causes of the fall in output were given as due to the war and its consequences, the displacement of coal by oil, and fuel economies.

When nature has supplied an abundance of petroleum for the mere drilling of a hole into the earth, it is not much that man can afford to spend upon converting her coal into oil, however clever he may become at it. The amount of benzol available for high-temperature carbonization of coal in gas retorts and coke ovens would be too small a proportion of total requirements to be counted seriously, and the production of motor spirit and fuel oil by low-temperature carbonization is doubted by some. Sir Richard Redmayne's scheme ("Nineteenth Century and After," Feb., 1933) was criticized on the grounds that it is doubtful whether 50,000,000 tons per annum of suitable coal for low-temperature carbonization would be available, that new difficulties of transport of a solid fuel lighter than coal would arise, and that the production costs are too low. The lecturer did not consider that low-temperature semi-coke was worth its present price as against a good house coal and that Parliament would not be justified in prohibiting the use of raw coal in large cities. The process of obtaining motor spirit by the hydrogenation of coal, although technically feasible, in present circumstances is economically impracticable. A three-years' trial of a plant producing 30,000 tons of petrol per annum was recommended by the speaker so as to develop further hydrogenation experience and to ascertain what the costs of production would be.

We ought to concentrate our research upon the solution of the problem of utilizing de-ashed pulverized coal in internal-combustion engines, the whole question of de-ashing coal and using it for power purposes being of the greatest importance. It was pointed out that when Diesel set out to develop the engine now called after him,

his idea was that it should use pulverized coal. The ash problem was, however, so great that it was adapted for heavy oil fuel. Considerable progress has been made with the original idea by Pawlikowski, and experimental engines developing 150 h.p. have been successfully run on various types of pulverized coal including some British coals. Little alteration is required to adapt a Diesel engine for this purpose, the main requirement being a special admission valve for the fuel and a pre-combustion chamber. No valve trouble has been encountered and the only serious mechanical difficulty is caused by leaky piston rings. The engine has been run for 1000 hours continuously with an average effective load of about 130 h.p. and a thermal efficiency of 31·5%.

In conclusion it was suggested that our research policy in carbonization, hydrogenation, and countering the inroad of oil should be mainly left to the industries concerned. The coal industry should raise its own research funds to investigate all other problems relating to cleaning and marketing of coal, including the de-ashing of coal and comprehensively the use of pulverized coal.

A vote of thanks, proposed by Mr. D. C. Griffiths, seconded by Dr. H. B. Watson, was carried with acclamation.

SCIENTIFIC AND INDUSTRIAL RESEARCH*

In its report which was issued recently the Advisory Council of the Department of Scientific and Industrial Research stresses the need for industrial research at the present time, and says " . . . we hope that the protection which has now been afforded to certain industries in the home market will be regarded as an opportunity for effecting the changes in organization, the installation of modern plant, the development of research work, and the employment of educated staffs which the experience of the last few years has shown to be necessary in some industries if they are to compete on level terms with industries in other parts of the world. No industry can afford in these times to neglect any opportunity for increasing its efficiency and, of all the means to this end, the pursuit of research and the application of the results achieved are often the most far-reaching and fruitful."

Referring to the work of the National Physical Laboratory it is pointed out in the report that in no other branch of the Department's activities were the effects of the industrial depression of 1931 felt more acutely. The actual industrial receipts showed a deficit from the estimates of £12,000. Although some of the more fundamental work of the laboratory has been slowed down by not appointing new staff to fill vacancies, it is reported that the laboratory is as well-prepared as heretofore to give to industry the direct assistance for which it has learnt to look. In the physics department the thermal and electrical conductivity of alloys over a range of temperature up to 800° C. have been investigated and results obtained for monel metal and a commercial nickel-chromium alloy. Other investigations are proceeding into the energetics of *X*-ray production, and considerable progress has been made in the scattering of homogeneous *X*-radiation by a range of materials of low atomic number.

* Report of the Department of Scientific and Industrial Research for the year 1931—32. Pp. iv + 193. H.M. Stationery Office, 1933, 3s.

With regard to fuel research the report refers to the recent development of narrow brick retorts for the low-temperature carbonization of coal at the Fuel Research Station, and emphasizes the importance of the comprehensive scheme now in hand for studying under semi-commercial conditions processes for the conversion of the tar produced through the carbonization of coal into motor spirit and oil fuel. "The fuel problem," the report continues, "is perhaps the most crucial problem with which the Department is faced. . . . We therefore thought it desirable, during the course of the past year, to carry out a review of the arrangements made for the conduct and direction of the Department's researches on fuel. What emerged most clearly from this review was the importance in fuel research, as in other branches of applied research, of provision for an effective programme of laboratory work. In the laboratory the research worker is free from the restrictions in planning his work which are inevitable when experiments have to be conducted on a large scale, while intensive laboratory work is the best way of developing that real understanding of root problems which may lead not merely to improvements of a relatively minor nature in existing processes, but to suggestions for radical changes in production or in methods of utilizing a raw material."

It is pointed out that in some directions the results of the researches can find direct application, but in others the work of the Department is but a part of the chain of development leading from the discovery of a promising laboratory process, through small and large scale trial, to the full-scale commercial plant.

Under the heading Metallurgical Research, the behaviour of materials at high temperatures is dealt with. Creep tests on high nickel and high chromium steel have been completed, and a comparison of the creep properties of a variety of commercial steels is being carried out in co-operation with the Kaiser Wilhelm Institut für Eisenschung in order to correlate the results of short-time creep tests carried out there with long-time tests made at the National Physical Laboratory. Further work by the British Non-Ferrous Metals Research Association has been directed to the cupro-nickel alloys. Tests show that the addition of a small percentage of arsenic has little effect, and the effect of the addition of other elements such as chromium and cobalt is being investigated.

A new design of cupola for the manufacture of cast iron, developed by the Cast Iron Research Association, is giving very satisfactory results in practice, not only in fuel economy, but in the reduction of wastage. One firm for example, who found their defective castings totalled 4·4 per cent over a period of ten years prior to the installation of the new cupola, reduced this figure to 0·7 per cent in one year by its use.

The work of the Food Investigation Board has already been detailed in the Board's Report (cf. CHEM. AND IND., Aug. 19, 1932, p. 704) and in this report attention is called to the work which is being done on the preservation and transport of food, particularly with regard to refrigeration and the fungicidal effect of low concentrations of carbon dioxide.

The recently formed Research and Standardization Committee of the Institution of Automobile Engineers, to which the Department contributes financially, is

using a new instrument in investigating the problem of silencing, and has made exhaustive wear tests on a large number of brake drum and clutch-plate materials. In addition, work on cylinder and piston wear is being actively pursued.

With regard to chemical research, the report states that it is becoming increasingly evident that the Chemical Research Laboratory, under Prof. Morgan, is beginning to be appreciated as an institution where useful information can be obtained. About 21 firms and organizations applied for advice and assistance during the year. The report deals with corrosion research, the high pressure research by which the higher alcohols, including a new heptanol, have been produced, tar research, in which further progress has been made in the identification and characterization of the chemical constituents of low-temperature tar, road tar research, chemotherapy, synthetic resin, and water pollution research. Two olefines and four naphthenes have been added to the list of new components of low-temperature tars, whilst hydrogenation experiments with molybdenum sulphide catalysts on resinenes, resinols, and resinamines have given considerable yields of light oil.

A NEW DIAGRAM OF THE PERIODIC TABLE

By Dr. F. W. RIXON

(1) The chemical properties of an element depend mainly upon the number of electrons in the outer shell of the atom.

(2) An element may be said to strive towards an ideal, which is the completion of an electronic structure as close as possible to that of the rare gases. This "ideal" may be approached by various methods that have been termed polar, non-polar, and semipolar linkages.

(3) Elements will have similar chemical properties if they possess either a similar number of electrons in excess of the nearest rare gas or the same number in defect of the neighbouring rare gas.

(4) Any element is situated between two rare gas neighbours, and has two options of attaining an ideal structure, one by acquiring electrons, the other by donating them, the nearest neighbour exercising the greater influence, but every element has this dual tendency or amphoteric character.

These four statements, which are recognized to be a very incomplete summary of the connexion between chemical properties and atomic structure, form the basis of the accompanying diagram, in which the elements, in the order of their atomic numbers, form a broken line so that elements, the shells of which differ by an equal number of electrons from their neighbouring inert gases, appear on the same level. The two short periods are duplicated to include these elements in both their attributions, namely, electrons above and below the inert gas structure. In this way it will be seen that beryllium and magnesium form a family group with calcium, strontium, barium, and radium, all of them having an excess of two outer electrons in respect to their preceding rare gas, or two over the magic eight, at the same time beryllium and magnesium are six electrons in defect of their neighbouring rare gas, possessing in this way a likeness to zinc, cadmium, and mercury, a resemblance less marked than the former but still to be recognized as such. See also Li, Na, K, Rb, Cs and Li, Na, Cu, Ag, Au; F Cl, Br, I and F, Cl, Mn, Ma, Re; C, Si, Ti, Zr, Hf and C Si, Ge, Sn, Pb, etc.

These relationships, the groups A and B of the usual periodic table, can be seen in other arrangements, for example the one by Thomsen, Soddy's helix and Harkin's cylinder, but the system used in this diagram appears satisfactory in combining the presentation of the groups in a simple graphic manner with a reason for such grouping.

The system actually appears to work out better than it deserves, based as it is upon a simple generalization which is hardly strictly true, since the progressive series of elements is not carried forward by the growth of a single shell but is complicated by a double shell growth. In the case of the transition elements the inner shell is growing down the series, while the outer shell, which determines many of the characteristics, remains constant; in the rare earths two outer shells remain constant, while the third is growing, giving the well-known embarrassing chemical similarities in this group of elements. A thin line running by the thicker line marks the transition elements in the diagram; the rare earths have been compressed under the heading which is placed on the characteristic chemical level for the whole of them.

Symbols and atomic weights have been included for convenience of reference, and over each element is a small figure or there are small figures indicating the number of electrons in the shell or shells, which are growing in the particular period. The rare gas shells are given in full.

A consideration of the various quantum levels would introduce too much detail, and would not appear to add much to the chemical value of the table.

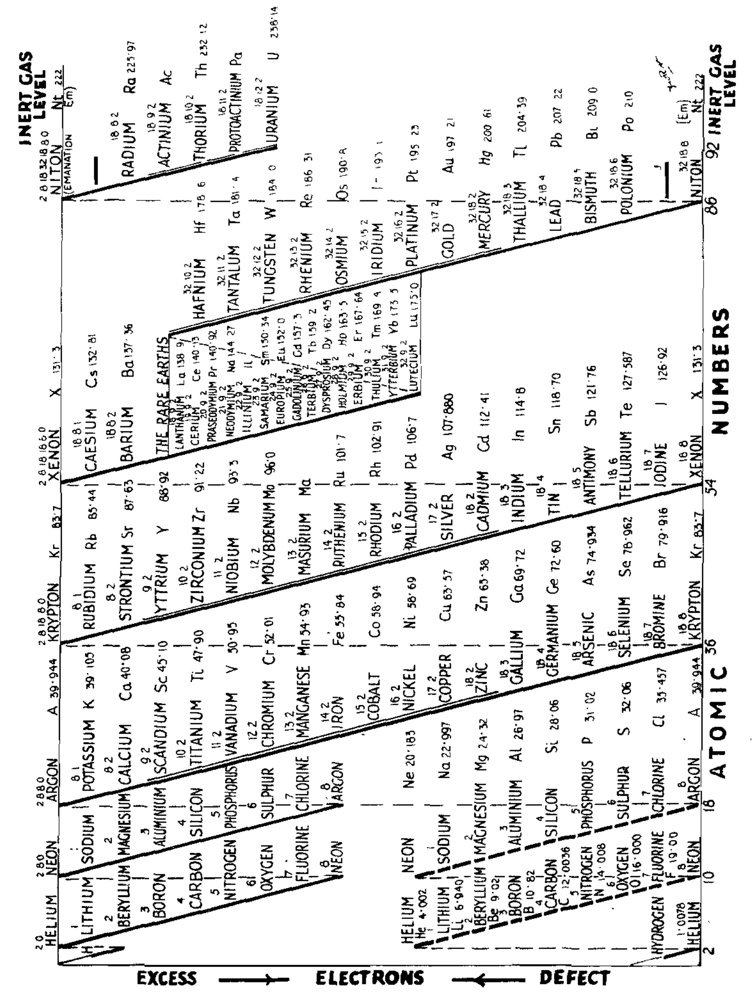
Certain liberties have been taken in a few cases, Cr [13·1], Cu [18·1], Nb [12·1], Mo [13·1], Rn [15·1], Rh [16·1], Pd [18·0], Ag [18·1], An [18·1], U [13·1]. These have been shown with two electrons in the outer shell.

It is usual to represent them by the figures given in the brackets above, the chemical reasons for so doing are so slight and debatable that the growth has been set out as continuous in one shell with a pair of electrons in the outer shell.

There is a certain variation in the number of elements included in the transition series, to be found in the literature. In this diagram all have been included in which the outer shell is not growing. The limitations of a graphic representation such as this are reached when reference has to be made to the more intimate structure of the various atoms, but it does seem to furnish a setting of groups and periods, which displays a large number of useful relationships with a certain amount of reason for the relationship.

It is put forward as a fairly satisfactory graphical presentation of periodicity and an aid to the study of the chemical properties of the elements in the light of their atomic structure.

University of Bristol
Feb., 1933.



The elements arranged according to their atomic numbers and their positions with respect to the rare gases. Groups read from left to right. Periods down. Atomic weights follow the symbol. Small figures above names are the number of electrons in the shells which are filling up in the period.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Annual Reports. Volume XVII, Reports of 1932, is now ready. Members 7s. 6d., others 12s. 6d., post free. All advance orders have been executed. Claims for non-delivery must be made at once to the General Secretary.

Local Sections. Every member is attached, without fee, to the Local Section nearest his place of residence. Any member not in regular receipt of notices of his local meetings should communicate with the local Honorary Secretary. See the JOURNAL of January 6, page 6 *et seq.*

Food Group and Plastics Group. These subject Groups are open to any member of the Society interested in the subject concerned, free of cost. Particulars may be obtained on application to the General Secretary.

Plastics Exhibition. We published last week information concerning the Exhibition at the Science Museum in the staging of which the Plastics Group is taking a prominent part. The Gen. Secretary has a few invitations to the private view from 11 a.m. to 3 p.m. on the opening day, Wednesday, April 5. Members interested in plastics and wishing to attend should apply for tickets to 46, Finsbury Square, E.C.2, and state if they will be accompanied by a lady.

AMERICAN SECTION

A meeting of the American Section of the Society was held on February 25 at the Chemists' Club, 52, East 41st Street, New York City. Mr. A. E. Marshall, chairman, presided, and a paper was presented by Mr. Sheppard T. Powell, entitled, "The Creation and Correction of Trade Waste Problem."

The paper was a critical survey of present and indicated future trends of created economic losses resulting from industrial activity and included a comprehensive discussion of the impracticability and inadequacy of current thought, as reflected from many existing regulatory laws. Mr. Powell traced these apparent chaotic conditions to unwise legislation and unsound economic policies and to a general apathetic attitude of industrial management toward created wastes. He suggested a specific programme for constructive co-operative regulation, to include co-operative group investigation, intelligent legislation and conservation, and development of useful recoverable products.

JOINT MEETING OF BIRMINGHAM SECTION AND CHEMICAL ENGINEERING GROUP

On Friday, March 17, the Birmingham and Midland Section received a visit from the members of the Chemical Engineering Group, and in the afternoon a party of about 40 visited the Bournville Works of Messrs. Cadbury Bros. The party was entertained to tea, and on behalf of the firm Mr. George Cadbury gave them a cordial welcome, which was acknowledged on behalf of the visitors by Mr. J. Arthur Reavell.

In the evening a joint meeting, over which Mr. H. W. Rowell presided, was held at the University of Birmingham, when an interesting paper on "Personnel in Industry" was read by Mr. W. A. S. Calder, F.I.C., M.I.Chem.E. (vice-chairman of the Group).

Mr. Calder paid tribute at the outset to the extraordinary response made by chemists and engineers to the country's call during the war years. The whole staff connected with H.M. Factory at Oldbury carried on at times under most difficult and trying circumstances with a selfless devotion to duty; this devotion was by no means confined to the Midlands, and all felt that the members of the chemical profession were second to none in the sacrifices they made.

There was, said Mr. Calder, no need to group personnel into classes. The ratio of good, bad, and indifferent performers was about equal in all the so-called grades of society: there was at least no disposition on the part of workmen to take a less broad and generous view of any proposal to deal with troublous times than would be taken by high officials. High individual ability was sometimes a problem in that it was apt to clash with the team work without which collective efficiency was impossible. "You do tend to cramp the style of eagles by putting them into cages, but you can't have a number flying about on their own." The broad general principle which it was necessary for all to observe in a desire for co-operation was to realize the respective duties which they owed to their subordinates, colleagues, and superiors. Real discipline was necessary but it should not be irksome.

It was eminently desirable that all should have a clear conception of the duties for which they were responsible: these should be closely defined and should always include the giving of help to other departments when requested. We were all familiar with the type of man who was always anxious and eager to do everything which was in no way connected with his own job!

There was a general rule which the lecturer always laid down to chemists and engineers in charge of departments, and which has recently been returned to us by the United States as a new maxim! It was that the relative importance of their duties should be placed in the following order: (1) Safeguarding the men under their control; (2) Maintaining or improving the quality of the products turned out; (3) Improving efficiency and reducing costs.

In connexion with maintaining the confidence of others it was essential that all promises should be fully implemented, whether the promise referred to improved position, improved remuneration, or improved conditions.

It was always a difficult problem to make readjustments in staffs, but his own view was that there was a good deal to be said for the devil one knew rather than the devil one did not know, and under ordinary circumstances only the hopelessly lazy and dishonest should be discharged. When dismissals were decided upon it was usually better that they should be made immediately, and the most generous financial arrangements made in lieu of notice.

The varying types in the personnel of industry were well shown up by reports. There was the man who would furnish a report promptly and quantitatively, but of the sort one hated having to wade through, and at the other end of the pole the man whose reports were concise, clear, and a delight to read, but with

whom almost personal violence was necessary to obtain a report on anything. Reports should have a limiting factor introduced: in this connexion, now that the question of the finances of so many of our Societies was so prominently to the front, would it not be possible, said the lecturer, to cut the cost of printing right into two in the middle by condensing much of the matter into more reasonable proportions? There seems to be a disposition to forget the difference between filling up the columns of a newspaper where a certain amount of space has to be occupied, and the recording of observations in papers, reports, or lectures.

While it was necessary to define clearly and effectively the scope of each man's particular duties, it was essential that the water-tight compartment system should be discountenanced. There was still a point in the old story of the railway company of which one department successfully designed and constructed locomotives of magnificent proportions, only to have it pointed out by another department that the existing bridges rendered it impossible for such engines to be run over the system!

The average healthy man was convinced that he was worth more than he was getting, and it would be a fatal thing if this were not the case, and an obvious factor in promoting contentment was the question of the possibility of some financial return over and above the fixed salary or wages. The cultivation of a true sense of proportion by all concerned was the key-note to obtaining the best results from personnel.

Mr. J. A. Reavell moved a vote of thanks to Mr. Calder.

Mr. S. J. Tungay, Mr. G. B. Jones, Dr. A. J. V. Underwood, Mr. D. W. Parkes, Mr. J. McRillop, Mr. F. M. Potter, Mr. Rhead, Dr. E. B. R. Prideaux, and Major L. J. Barley, and Mr. Rowell took part in the discussion. An informal dinner followed at the Imperial Hotel, with Mr. J. Arthur Reavell presiding. Some interesting films taken at concerts and social events connected with the Society of Chemical Industry by Mr. George King were shown.

LIVERPOOL SECTION

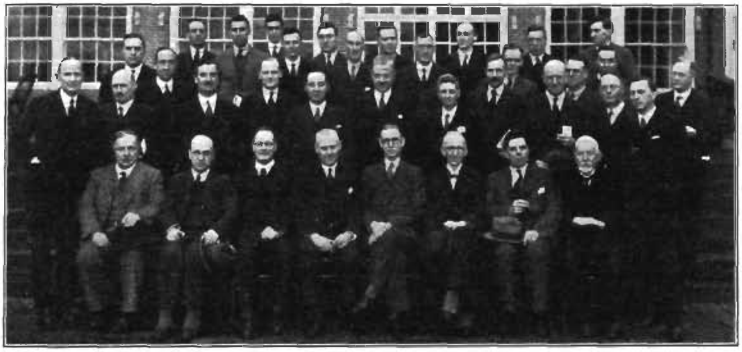
The annual meeting of the Liverpool Section was held in the Chemistry Department, the University of Liverpool, on Friday, March 17. The chairman, Mr. E. Gabriel Jones, referred to the death of Mr. G. W. Malcolm, joint managing director of Salt Union, Ltd., for the past thirteen years a member of the Section, and on a motion from the chair a unanimous vote of sympathy with the relatives was passed, all present standing in silence.

The officers and committee of the Section for the forthcoming session were elected as follows: *Chairman:* E. Gabriel Jones; *Vice-Chairman:* Dr. W. Trantom; *Hon. Treasurer:* A. E. Findley; *Hon. Secretary:* H. Raymond Feeny; *Representative on Chemical Engineering Group:* W. Ramsay Sibbald. *Committee:* Prof. C. O. Bannister, G. Brearley, L. V. Cocks, W. M. W. Fell, Prof. T. P. Hilditch, B. D. W. Luff, J. Richardson, Assoc.-Prof. W. H. Roberts, Dr. R. Thomas, Edwin Thompson, S. Gordon Smith, and J. S. Towers.

A lecture on "Scientific Disarmament and Security" was then delivered by Major V. Lefebure (R.E.), B.Sc., and a lively discussion ensued, those taking part including Messrs. J. Lord, Clarence Mold, Dr. W. Trantom, Mr. E. T. Williams, and Mr. E. H. Shepherd.

In the early part of his paper Major Lefebure stressed the fact that the background of the subject was definitely technical. This emerged clearly if one assumed the objective of disarmament to be to prevent or reduce aggression to the maximum possible extent—although the records revealed solemn discussions having in mind only economy, or the stabilization of an existing position by unilateral disarmament.

There was an unlimited number of possible ways to organize and distribute armaments from nation to nation. Amongst these combinations it was possible to find some which satisfied the pre-war objective, *i.e.*, the quick release of world war. Was it equally possible to find a new orientation which satisfied the converse or the disarmament objective? The world had tacitly



PARTY VISITING WORKS OF CADBURY BROS., LTD., BOURNVILLE

assumed that it was possible, without finding out if it were so. Assuming however that it were so, the principles which should guide such redistribution of national armament became essentially a technical one, involving working principles, quantities, times, and their consideration in relation to a very specific effect or performance.

For more than ten years there had been a concerted effort to solve the problem of the principles which should guide such redistribution. It had been a fantastic effort, probably the first time that the world had ever spent from five to ten million pounds on a thought process, an intellectual problem. This effort had produced extremely little result, and, some say, had reached stalemate, if not checkmate. It was one of the first examples in the history of the world of an international effort to solve a strongly technical problem.

The object of disarmament was to reduce to a minimum the chance of settling international disputes by violence, *i.e.*, to reduce to a minimum the chance of successful decisive surprise attack in, say, a few days or a few weeks, and secondly, to increase the time interval to the maximum before which it would be impossible to reach a final decision. It was at first apparent that disarmament must deal with the striking force, *i.e.*, mobilized or easily mobilizible men and materials. The study of disarmament had to deal not only with the men and materials of the striking force, but also with such factors as reserves, stocks, and the means of production, whilst the development of new agencies of war had also to be considered. There were no records of any early systematic discussion on the subject, and the well-known Esher scheme was, perhaps, the first in which it was proposed that nations should reach a condition of disarmament by reducing home effectives. There was no reference to material or manufacture or any of the other basic aspects of disarmament. Then we found a Commission sitting at Brussels on the problem of chemical disarmament. The Commission was asked whether in regard to materials, say quantities of chemical or aggressive devices, the same principles of disarmament could be applied as were envisaged for normal armament. It seems to have been assumed that the principles were common knowledge, and that there was no need to agree upon and adopt any definite ideas. This Commission reached no result.

In 1926 a real attack was made by the grouped Governments at Geneva on the genuine problem of disarmament, *i.e.*, the physical problem. It took the form of the Preparatory Commission, whose duty was to prepare an agreed draft convention which would serve as the agenda of a forthcoming world disarmament conference. They laboured for five years and were supported by a sub-commission, but they gave the scantiest attention to two fundamental aspects of disarmament, the means of rapid expansion and new weapons. In 1927 began the meetings of the Preparatory Commission, based on the idea that the whole subject had been worked out for them. With the aid of the Sub-Commission's report they wanted to start from first principles and build up a rational conception of disarmament, but the old political methods defeated the technical aspiration. Great Britain tabled a draft convention of her own, France followed this procedure, and these two drafts were merged into the Synoptic Analysis. The total effect was to narrow the world discussion on disarmament to what was technically a totally inadequate field. The Synoptic Analysis contained no reference to such things as manufacture, new weapons, or chemical warfare. Thus, when the World Conference met in 1932, a number of nations were asked to come to agreement on an important subject, the half of which had not even been ventilated. Thus, in quick succession, new matter was added not contained in the Draft Convention, such as manufacture, the private armament industry, chemical warfare, and a modified form of direct limitation, termed qualitative limitation. The examination of various essential disarmament subjects was officially supposed to begin in 1925—26, but only began late in 1932.

In connexion with chemical warfare at the Brussels Conference in 1920, the League Council put a series of questions to the technical body, *i.e.*, the Permanent Advisory Commission. They first asked whether the chemical weapon was cruel: the Commission answered that it was. The Commission, dealing with manufacture, stated also that it would be useless to seek to restrict the manufacture of poison gases in peace as a quantitative method to check use in war. No facts, and no grounds of any sort, were advanced. It was not explained, for instance, that the chief and practically all of the actual chemical casualty-producers were not actual commercial commodities: there would therefore in any case be a definite conversion lag, and if such production were limited to State production there might be some value in such measures. Regarding research the Commission simply replied that the prohibition of laboratory experiments was out of the question. No explanatory matter was given at all. After various arbitrary answers of this sort, useless to any statesmen, the Commission calmly referred the matter back to humanity.

MANCHESTER SECTION

A joint meeting of the Manchester Section of the Society of Chemical Industry, and of the Manchester Section of the Oil and Colour Chemists' Association was held at the Engineers' Club, Manchester, on Friday, March 3, Dr. T. Callan, M.Sc., F.I.C., presiding.

Dr. V. G. Jolly, B.Sc., read a paper entitled "The Accelerated Weathering of Paints and Varnishes," in which he said he proposed to deal with the attempts made to break down paint, varnish, and lacquer films, by submitting them to varying conditions of moisture, light, heat, and cold, uncomplicated by the presence of chemical agents in the form of industrial gases or salt solutions.

A dried oil paint film consisted of a high concentration of a pigment embedded, and sometimes chemically combined with, a plastic matrix of linoxyn or oxidized drying oil. An enamel paint film contained a lower concentration of the solid pigmentary constituents and the medium or vehicle carrying them was often rather harder owing to the presence of hard resins. In both cases the film was dependent for its resistance to weathering influences on the nature of the solid pigment, and the

plastic drying oil medium, and the relation of the one to the other. It was known that the incidence of sunlight on such a film was attended by obscure photo-chemical reactions between the complex compounds present in the linoxyn, and as these reactions took place the uniformity and usefulness of the film decreased. It lost its elasticity and contracted with a consequential loss of its hold on the embedded pigment particles. The result was a slight powdering of the surface of the paint known as "chalking," which might be succeeded by cracking. Chalking was more commonly observed in paints containing certain white pigments. Sometimes cracking took place without chalking. The vehicle was more or less protected by the solid pigment which was often capable of absorbing those wave-lengths in the sun's spectrum responsible for the photo-chemical changes in the oxidized oil.

The absorption of ultra-violet light by paint vehicles had also been measured by Stutz, who observed that the absorption was increased by bodying a raw oil by means of heat treatment or blowing with air, also by exposure to ultra-violet light. Such treated oils which were commonly used as paint vehicles, and clear varnishes also, had a high absorption capacity for the shorter ultra-violet wave-lengths (under 2800 Å). These were said to be absorbed at the surface, thus accelerating the hardening of the latter, whereas the higher wave-lengths were less easily absorbed and might therefore be expected to exert their action more uniformly throughout the film. These results pointed clearly to the risk of utilizing, for accelerated weathering purposes, wave-lengths which were absent from the sun's spectrum.

The action of sunlight and ultra-violet light from a quartz mercury lamp had been contrasted by Clark and Tschentke who studied their effect on the density of drying oil films. They found that sunlight created greater density changes in the surface than in the under layers of the film, whereas the mercury lamp radiation had a more uniform action. Sunlight therefore, could give rise to a physical incompatibility of the surface and under layers of the film with consequential cracking. Comparative determination carried out in darkness emphasized the importance of photo-chemical action and pointed to the probability that light may initiate rearrangements which proceed at a velocity independent of the effect of any further irradiation of the film and these might contribute to the final breakdown.

All drying-oil films were more or less permeable to water and a variety of effects became possible when water was allowed to permeate the plastic film. With less resistant materials such as clear varnishes, emulsification of the surface took place, resulting in discontinuity and the development of stresses when the material dried out again. Rapid alternations of humidity were thus likely to play a big part in determining the life of an oil film, more particularly if they took place simultaneously with changes in temperature and in sunlight. Further possibilities were encountered when the combined action of light and water was considered, and it was a matter of speculation to enumerate the likely effects of allowing radiation in the form of light or heat to fall on a film whose surface was more or less permeated with water. In a comprehensive series of tests on varnishes, Nelson found that the life of a varnish film could be shortened most effectively by subjecting it to a water spray, followed by exposure to light or refrigeration, and it was reasonable to assume that paints incorporating non-reactive pigments would behave similarly under such treatments.

It might be supposed that it would be an easier matter to formulate an artificial weather cycle to be comparable with conditions obtaining in tropical countries where the alternations of sunlight and moisture, heat and cold, were often more dependable than in England. This was open to doubt, however, for even in such places there were likely to be abrupt changes of humidity and temperature whose effect on the film was unknown, but which is suspected to be by no means insignificant. It was well to bear in mind that a small force or combination of forces such as a rapid decrease in temperature occurring simultaneously with a rapid increase in humidity, might be more critical in a strained film than larger forces regularly applied and increasing in intensity more slowly. Unfortunately, data were lacking regarding the precise chemical disintegrating effect of heat, light, and moisture, and one was obliged in formulating an artificial weathering cycle to consider, on the grounds of general observation and experience, what were the relative intensities of the weathering forces and in what proportion and order they should be used. The difficulties attendant on an intensive study of the mechanism of the breakdown of a drying-oil film might thus be covered by seeking a suitable cycle.

As Kempf had pointed out, paints designed for use in tropical countries had been known to fail rapidly when exposed in England and *vice versa*. Whether or not this was due to frequent precipitation of moisture on the warm films was not certain, but it suggested that in experimental cycles, rapid failure might be attained if the films were subjected to a cold shower of water immediately after a prolonged exposure to the artificial sunlight and heat radiation. Kempf had called attention to the fact that there was probably no such thing as average weather, for there was always the risk of sharp changes in temperature, such as accompanied a hail-storm, which might have a disastrous effect on the film. Such a change might occur in a year otherwise normal in respect of sunshine, rain, and daily and seasonal variations in temperature. The performance of a protective coating, furthermore, depended largely on the time of the year it was exposed, and in the case of a durable product, whether it started life in a cold season followed by a hot one or *vice versa*.

Agreement had been reached that the source of light was of paramount importance, since a source such as the quartz mercury arc, yielding a spectrum rich in ultra-violet wave-lengths, although causing rapid break-down could not be relied upon to simulate the natural effect of sunlight. In this respect the carbon arc lamp was to be preferred. Although the carbon arc spectrum was by no means identical with that of sunlight it was a fairly continuous one and might be expected to yield similar photo-chemical changes. On the other hand, the energy curve of the mercury arc rose sharply at certain wave-lengths in the far ultra-violet region which might conceivably induce unnatural chemical

rearrangements in the film, leading to stresses of a magnitude far greater than might be encountered under more natural conditions. Further, the source of light should be as constant as possible, and in this connexion the mercury arc lamp was at a disadvantage.

The open carbon arc was free from this drawback, but needed more attention owing to the replacement of carbons every few hours. A closed arc would continue without attention for 24 hours or more, but the globes needed cleaning and could not be guaranteed to maintain their transparency indefinitely. A nearer approach to the solar spectrum could be gained by using cored carbons, but these burned away more rapidly and further vitiated the atmosphere so badly that paint-films drying in the vicinity did not yield normal films. Tung oil films were particularly likely to web under these conditions.

The plain carbon arc emitted little energy of wave-lengths less than 3200 Å whereas the arc from white flame carbons, which are impregnated with fluorides of the rare earths, was stronger in that region and compared favourably with the sun. The pure carbon arc emitted a wide band of radiation at 2500 Å of low intensity band at 3890 Å (the cyanogen band) but with impregnation of the carbons or modification of their relative position or the current passing the intensity of these wave-length bands and other parts of the spectrum might be entirely changed. For example, a five-fold increase in the current might be attended by a fifty-fold increase in spectral intensity. It should be noted that even impregnated carbons emitted only a very small percentage of their total energy in the ultra-violet region, in that respect comparing favourably with sunlight. The quartz mercury arc, on the other hand, emitted a much greater percentage of its radiation in the ultra-violet, much of it in the shorter wave-lengths. The mercury arc, although considerably faster than the carbon arc in its action, seemed to favour that surface breakdown known as "chalking," and it had been shown by Schmutz and Gamble that the wave-lengths inducing this type of breakdown might be filtered out by glass transmitting nothing below 2690 Å. The filtered light, however, still induced cracking of the paint films. The spectral energy curves and other characteristics of available sources of ultra-violet light, such as tungsten lamps and arcs of nickel and tungsten, showed them to be unsuitable for accelerated testing.

MONTREAL AND OTTAWA SECTIONS

On Thursday, February 9, Dr. R. K. Stratford, chief research chemist, Imperial Oil Co., Ltd., addressed the Montreal Section of the Society at the Windsor Hotel, Montreal, and on the following day a joint meeting of the Ottawa Section of the Society and the Ottawa Branch of the Canadian Institute of Chemistry at 319, Queen Street, Ottawa, on the subject "Newer Developments in the Refining and Utilization of Petroleum Products."

The Montreal meeting was in charge of Dr. O. Maass, chairman of the Section, and was largely attended, while the Ottawa gathering, which also accorded the speaker an encouraging reception, was presided over by Lt.-Col. J. T. Janson, chairman of the Ottawa Branch of the Canadian Institute of Chemistry.

At the outset Dr. Stratford testified to the perseverance and ingenuity of petroleum engineers whose foresight had been responsible for the extraordinary development of the petroleum industry in the last decade. Chemists, too, had played an important part and the future of the industry lay with them rather than with the engineers. Until ten years ago crude petroleum was separated into various fractions by distillation in a shell still equipped with a very crude type of fractionating tower. The desired overhead fractions had to be treated with acid and re-run in another still at the cost of much labour and incidental loss. Dr. Stratford then indicated by means of charts how the original shell stills with their stone packed towers had first been brought together and how the stone packing had been replaced by a bell cap bubbling system. These changes had increased by 33% the capacity at Sarnia, where Dr. Stratford was chief research chemist of the Imperial Oil Company. Moreover a new type of still had been developed, termed a flash coil, in which the oil was heated continuously and the fractions taken off at various points in the tower overhead. The advantages of this system lay in the saving of space, fuel, operating costs, and the convenience of distilling high boiling point fractions without cracking.

Similar improvements had taken place in cracking. Starting with a single batch pressure still which was operated at pressures of from 50 to 100 lb. per sq. in. and at temperatures between 780° and 790° F., with yields of gasoline never greater than 30%, to-day equipment with heating coil, reaction chamber, and proper fractionating towers, operated at 1000 lb. per sq. in. and 900° to 1000° F., with yields of 50% to 60% high grade gasoline. Great changes had been made in refining, from the original crude intermittent treatment in agitators with sulphuric acid and caustic soda, to the present continuous closed system, with reduction in loss of oil and in quantities of chemicals used. Thus the engineer had played his part: it was now the chemist's task to break new ground in discovering new uses for petroleum products and new methods of refining. Indeed this had been happening quite recently. The chemist has already taken part in four major lines of development, viz., hydration, hydrogenation, adsorption, and extraction.

Hydration

The manufacture of the higher alcohols from cracking coil gases, particularly propyl and butyl, alcohols, had become very widespread for use not only as solvents but as starting points for many synthetic chemicals. The process was very simple. The carefully fractionated gas containing the maximum quantity of unsaturated compounds was first treated to remove combined sulphur and washed with strong sulphuric acid in a tower. By the action of the acid on the unsaturated compounds, alkyl hydrogen sulphate compounds were formed which on dilution with water liberated alcohols. The crude alcohol was distilled from the acid and after rectification washed with an acid-treated white oil which removed sulphonated

compounds and higher alcohols, leaving in the case of isopropyl alcohol a comparatively pure product. Redistillation and dehydration gave a product of 99% purity in the case of isopropyl alcohol. Generally speaking the yields varied from 60% to 80% and the cost had been so reduced that isopropyl alcohol now sold in direct competition with ethyl alcohol for solvent purposes.

Hydrogenation

Hydrogenation was a very flexible operation and produced many valuable products, such as high grade gasoline and very highly refined and stable lubricating oils. It had a big future in spite of the high cost of installation. The oil to be treated was first submitted to a pressure of 3600 lb., mixed with hydrogen, passed through an exchanger and then to a heating coil where the mixture of gas and oil was raised to a temperature of 900° F. In the reaction chamber it came into contact with a catalyst after which the oil was cooled, stripped of the hydrogen, and pumped to storage. The hydrogen was prepared by heating steam and well-fractionated refinery gases together. The reaction went on in two stages; first at 1800° F. where methane was reduced to carbon monoxide and hydrogen; then the gases were cooled to about 850° F., passed over a catalyst with more steam, when carbon monoxide was oxidized and more hydrogen produced. Carbon dioxide was then removed and hydrogen passed to the system.

The four principal products which could be made by hydrogenation were: (1) Gasoline; (2) Improved low-grade kerosenes; (3) Lubricating oils; (4) Many petroleum specialities, such as safety aviation fuels and high grade solvents.

Adsorption

For many years the rôle of the chemist in the refining of petroleum had been simply to standardize the operations of the refinery and to insure a uniform product for the market. It was unfortunate that the earlier chemists found sulphuric acid so simple and safe a method for refining their products, for as a result this method of treating had persisted so that to-day many thousands of dollars were lost annually because of the waste attending the use of sulphuric acid. The probable explanation of this would be found in the fact that the development of the industry had been so rapid that little thought had been given to more economical methods of treating. While acid was still extensively used as a treating agent, its cost was little appreciated by the average refiner.

Notable among the attempts made during recent years to eliminate acid treating was the use of activated Fuller's Earth or Bentonite for the stabilization of cracked gasoline. The Imperial Oil Refineries at Sarnia had developed a process by which the vapours of the product under refinement were passed counter-currently through a slurry of naphtha containing an active clay in suspension. In this way gasoline was treated so that gum-forming materials were eliminated, and at the same time good colour and stability obtained.

Extraction

Some fifteen years ago Dr. Edeleanu had first demonstrated the possibility of extracting the undesirable constituents from Roumanian refined oil by the use of liquid sulphur dioxide. After much difficulty in installing plants for this purpose the scheme had become successful to-day. Many plants existed throughout the world for efficiently separating the aromatic and unsaturated hydrocarbons from the more paraffinic types occurring in kerosene. A new system had been in operation in Sarnia for two years for refining lubricating oils with phenol, which had proved simple and economical. After drying the oil with air and heating to 100° to 105° F., it was contacted with substantially anhydrous phenol in a counter-current treater. The treated oil was charged to a still where 8% to 12% phenol was distilled off and returned to the phenol tank. The treated oil which was stripped of all but minute traces of phenol was then finished by treatment with a small quantity of active clay. The extracted oil or extract, as it was called, was charged to another still where the phenol was recovered by distillation. By this simple process the oil was improved in every characteristic, namely, colour, colonr stability, resistance to sludge formation, good temperature-viscosity relationship, etc.

Three of the four developments, namely, hydrogenation, adsorption, and extraction, were for the main part improvements in the refining of hydrocarbon oils and had not resulted in material increase in the number of products prepared from petroleum. There were obstacles in the way of producing specialities from petroleum oils, particularly if made from oils having peculiar properties. Then there was always the uncertainty as to the variations in crude oils from different fields. Up to the present, the main progress in refining had been to improve the quality of products on the market, such as gasoline, fuel oil, lubricating oil, asphalte, etc. and at the same time to minimize the cost of production.

Discussion

In Montreal Dr. J. B. Phillips inquired if the phenol process described by the lecturer was merely one of extraction or if chemical action was involved. Dr. Stratford replied there was no chemical action. Mr. J. B. Bell wished to know if, in recovering the phenol, any use were made of the hydrocarbons extracted. The lecturer stated that they could be used. Mr. Law asked if cresol could be used instead of phenol and was advised that it was not efficient.

An affirmative reply was given to an inquiry as to whether alcohols higher than propyl could be produced from crude oil. In the same connexion Mr. T. W. Smith asked about these higher alcohols and was informed that the demand was for isopropyl. Mr. Finlayter, of Moncton, N.B., inquired if the phenol process could be applied to the refining of other oils than lubricating oils. Dr. Stratford said that some crudes formed emulsions and therefore could not be used, but it could be applied to kerosenes.

In Ottawa, Dr. Stratford's paper provoked a number of inquiries and some discussion. Mr. F. J. Hambly asked if the clay were recovered, to which an affirmative reply was given. He remarked on the modesty of Dr. Stratford and felt that chemists should not hide their light under a bushel, because in the case in point

the credit for progress lay with the chemist rather than with the engineer. Mr. E. A. Thompson asked if the clay came from the Death Valley and whether British Columbia Bentonite could be used, but he was reminded of the cost of hauling it over the mountains. Others taking part in the discussion were Messrs. E. N. Gougeon, R. D. Whitmore, and R. E. Gilmore. A vote of thanks proposed by Mr. P. V. Rosewarne and seconded by Dr. G. S. Whitby was carried with enthusiasm.

OTTAWA SECTION

Dr. C. J. Watson, of the Division of Chemistry, Central Experimental Farm, Ottawa, was the speaker at the monthly meeting of the Ottawa Section of the Society of Chemical Industry, held on January 19, at 319, Queen Street, Ottawa, under the chairmanship of Mr. Ross E. Gilmore. Dr. Watson's subject, "Some Investigations in Animal Nutrition," was a review of a new field of work undertaken at the Experimental Farm in Ottawa.

Dr. C. J. Watson opened his remarks by explaining the need for such work on animal nutrition as had been embarked upon at the Central Experimental Farm, Ottawa, by the Divisions of Chemistry and Animal Husbandry. Slides were thrown on the screen illustrating the equipment and charts employed to indicate what had been done up to the present time.

Data were being gradually accumulated with regard to the digestibility of Canadian feeding stuffs. Not only were the common roughages and concentrates being evaluated, but also new proprietary products which appeared on the market from time to time. In addition to the routine determination of coefficients of digestibility, experimental work had been undertaken in animal nutrition. Of particular interest was the study of the effect of the plane of nutrition upon digestibility. The results so far obtained indicated that within certain limits the plane of nutrition did not affect the coefficient of digestibility of roughages. Another important investigation was the effect of the association of feeds upon the individual digestibilities. A preliminary survey indicated that the addition of some foods might increase the digestibility of a ration, whereas the addition of others appeared to have the opposite effect. These changes in digestibility appeared to be related to changes in the bacterial fermentation in the digestive tract of ruminants. That such might be the case was demonstrated by a study of the effect of the addition of pure nutrients upon the digestibility of a ration. As pure nutrients, corn starch and casein were selected. It was shown that starch depressed the digestibility of a feed whereas casein had no effect. Further, the conclusion was drawn that when casein was added to a ration containing starch, the depressive action of the latter was largely counteracted. The application of these findings to the question of associative digestibility was discussed.

CHEMICAL SOCIETY

At an ordinary scientific meeting held on March 16, the president, Prof. G. G. Henderson, F.R.S., occupying the chair, Dr. G. F. Marrian opened a discussion on "The Chemical Constitution of Œstrin." The following is a summary of Dr. Marrian's contribution :—

The phenomenon of œstrus or heat in female animals is caused by a hormone secreted by the ovaries. This hormone may be extracted from ovarian tissue with fat solvents. Such extracts when injected into ovariectomised animals lead to the appearance of an artificial œstrus period. The urine from pregnant women and mares contains large amounts of œstrogenic principles with a similar action. The active substance in urine may be extracted with ether or chloroform, after a preliminary hydrolysis of the urine with acid.

In 1929 Doisy, and Butenandt, isolated a pure crystalline substance from human pregnancy urine which showed a high œstrogenic potency, Later work by these authors showed that the substance was a hydroxyketone of the formula $C_{18}H_{22}O_2$. Marrian in 1930, Butenandt, and Doisy in 1931, isolated a second active crystalline substance from human urine. It proved to be a trihydroxy-compound of the formula $C_{18}H_{24}O_3$. One of the hydroxyl groups was shown to be phenolic. The phenolic character of the hydroxyl group in the hydroxyketone was subsequently also shown to be phenolic by Doisy, and by Marrian and Haslewood. Butenandt in 1931 established the relationship between the two active compounds by showing that the triol could be converted into the hydroxyketone by dehydration with potassium hydrogen sulphate. This suggested that the hydroxyl groups in the former were attached to adjacent carbon atoms. The two compounds will be referred to as trihydroxyœstrin and ketohydroxyœstrin.

Adam *et al* (1932) by an examination of unimolecular films of œstrin derivatives, and Bernal (1932) by a crystallographic examination, showed that these compounds must possess a condensed ring carbon skeleton Previous work by Doisy which was accepted by Butenandt indicated that both compounds contained four double bonds. It was suggested therefore that the œstrins must be partially reduced anthracene or phenanthrene derivatives with aliphatic side chains amounting to C_4H_9. Marrian and Haslewood (1932) and Butenandt (1932) later showed that three aromatic double bonds only were present in both compounds. It followed therefore that the basic carbon skeleton must be a system of four condensed rings.

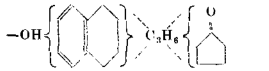
Examination of unimolecular films of certain reduction products of ketohydroxyœstrin by Danielli (1932) showed that the ketonic group must be situated at one end of the molecule (in ring 4) and the phenolic hydroxyl group at the other end (in ring 1).

Marrian and Haslewood (1932) obtained from trihydroxyœstrin by prolonged potash fusion a phenolic dibasic acid $C_{18}H_{22}O_5$. On heating with acetic anhydride and distilling, an anhydride and not a ketone was obtained. It is assumed therefore that the two non-acidic hydroxyl groups in trihydroxyœstrin (and hence also the ketonic group in ketohydroxyœstrin) probably are attached to a five-membered ring at the end of the molecule. Doisy (1933) has confirmed these findings.

Girard (1931, 1932) has obtained from mares' urine three other œstrogenic hydroxyketones. Two are isomeric substances of the formula $C_{18}H_{20}O_2$, while the

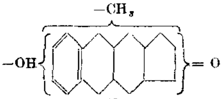
third has the formula $C_{18}H_{18}O_2$. The latter compound appears to have a naphthalene nucleus. Making the justifiable assumption that this compound possesses the same carbon skeleton as ketohydroxyœstrin, it may be stated with some certainty that ring 2 in the latter compound is six-membered.

The most complete structural formula for which there is at present any positive evidence is the following:

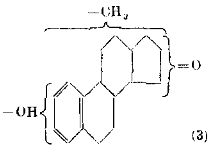


(1)

Assuming that ring 3 is also six-membered two complete skeleton formulæ are admissible from the unimolecular film work of Adam and Danielli, (2) and (3):



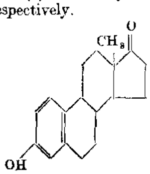
(2)



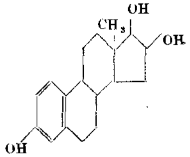
(3)

Of these (3) seems more probable in view of its *obvious relationship to the Rosenheim–King formula* for the sterols and bile acids. There is however no experimental evidence to show that the œstrins are related to the sterols.

Butenandt (1932) has assigned the structures (4) and (5) to ketohydroxyœstrin and trihydroxyœstrin, respectively.



(4)



(5)

There is no evidence that the substituent groupings are in the positions shown, other than by analogy with the Rosenheim–King formula for deoxycholic acid. It cannot be too strongly emphasised that the structure of the œstrins is not yet proved.

In the subsequent discussion, an account of which will be given in a forthcoming issue of CHEMISTRY and INDUSTRY, the following took part: Mr. J. F. Danielli, Dr. J. D. Bernal, Dr. J. W. Cook, Prof. E. C. Dodds, Dr. H. King, Prof. R. Robinson, Mr. E. M. Meade, Dr. N. K. Adam and Dr. G. F. Marrian.

BIOCHEMICAL SOCIETY

The annual general meeting of the Biochemical Society was held in the Department of Physiology and Biochemistry, University College, Gower Street, London, W.C., on Friday, March 17, when the following papers were read:

"The Mechanism of Anti-Glyoxalase Action," by J. O. Giršavičius. Glyoxalase is completely inactivated by a few hours' incubation with minute amounts of a suitable preparation of pancreatin; (a few mgm. per 100 c.c. liver extract). The actual inhibition is preceded by an induction period of variable length (up to several hours). After inhibition of the enzyme the liver extract still destroys phenyl-glyoxal, at a reduced rate, through non-enzymic reactions with tissue constituents.

The inactivated enzyme is reactivated by addition of reduced glutathione (GSH). Since previous GSH addition does not protect the enzyme against the "anti-glyoxalase" action of pancreatin (though it delays the process), one can conclude that "anti-glyoxalase" acts by depriving GSH, in the course of incubation, of its activating power. At the same time, however, the activating power of GSH is not diminished, when it is incubated with pancreatin alone, without liver extract.

"A Possible Mechanism of the Spermicidal Action of Aromatic Aldehydes," by J. M. Gulland and T. H. Mead. From polarimetric investigations of the interaction of sodium *d*-phenylalanine with isomeric dimethoxybenzaldehydes it seems possible that the superior lethality of the more spermicidal aldehydes is due (*a*) to their higher rate of reaction, and (*b*) to their more complete reaction, with the undissociated amino-groups of the spermatozoa. Further support for this view is obtained from a study of the titration curves of gelatin in presence of these aldehydes.

"The Fermentation of Mannose by Dried Yeast," by C. M. Jephcott and R. Robison. Comparative experiments have been carried out on the fermentation of mannose, glucose, and fructose by dried yeast in presence of phosphate. When fermentation was carried out at 25° the proportion of monophosphate to diphosphate obtained from mannose was higher than that obtained from glucose and fructose (36% against 18%—25%). The analytical values for the crude monophosphate obtained from mannose indicated the presence of both aldose and ketose esters. When the fermentation was carried out at 38° the proportion of monophosphate obtained from mannose was still higher (60%—80%), while the character of the product approximated more closely to that of mannosemonophosphate. In some experiments the monophosphate fraction appeared to consist almost entirely of mannose ester. Purification was carried out by preparing the phenylhydrazone, previously described, and decomposing this compound with excess of benzaldehyde at room temperature. The readily soluble barium mannosemonophosphate was also found to yield a sparingly soluble crystalline form and this provided a further means of purification.

The properties of the final product agreed closely with those already given for the mannosemonophosphate

isolated from fermentation hexosemonophosphate (prepared from glucose and fructose). The abnormally low iodimetric reducing power was investigated and it was found that mannose itself is more slowly oxidised than glucose, under the conditions employed for this estimation. By prolonging the duration of the test the theoretical values were obtained for both mannose and mannosemonophosphate.

The formation of such a large proportion of the mannose ester during the fermentation of this sugar must affect our views concerning the mechanism of the fermentation process, in particular as regards the conversion of the three hexoses into one common form as a necessary preliminary to their breakdown. This question is being further investigated.

"Adsorption of Simple Amino-acids by Purified Charcoals," by H. J. Phelps and R. B. Vallender.—Previous work has indicated that the adsorption of weak organic electrolytes is predominately apolar (*i.e.* in the un-ionised form) (Phelps and Peters, *Proc. Roy. Soc.*, A, **124**, p 584, 1929 and Phelps, *Proc Roy. Soc.*, A. **133**, p. 155, 1931. If this generalization may also be applied to the amino-acids it should be possible to gain some idea of the ionic structure of these bodies from adsorption data. If the amino-acids exist largely or exclusively in the "zwitterion" form at the iso-electric point they should be least adsorbed under these conditions. If, on the other hand, the classical, un-ionised, iso-electric form predominates, the adsorption might be expected to be maximal at the iso-electric point. The influence of hydrogen-ion concentration on adsorption has been studied using the technique already described (*loc. cit.*). The adsorption of alanine is found to be nil from approximately p_H 4·5 to p_H 6·5, rising considerably in more alkaline solution, and to some extent in more acid solution. In very acid solution the adsorption again falls off, as also does the adsorption of a fatty acid under the same conditions. It may be concluded from this result that alanine exists almost entirely in the "zwitterion" form in a charcoal-water interface.

The adsorption of leucine, on the other hand, falls steadily from p_H 6 to p_H 3, while in solutions more alkaline than p_H 6 the adsorption still rises slightly. The influence of hydrogen-ion concentration on the adsorption of α-amino butyric acid is similar, there being a more rapid fall in adsorption in solutions more acid than p_H 6 to small adsorption at p_H 4, which appears to be maintained in more acid solutions. To explain these results it must be assumed that both the "classical" and the "zwitterion" forms of these acids exist in the charcoal water interface, and that the influence of an un-ionised amino group is a factor of greater importance in adsorption than an un-ionised carboxyl group; for which assumption the results obtained with alanine also give good grounds. It is interesting to recall the influence of hydrogen-ion concentration on the adsorption of the complex amino-acid histidine, which has already been described (Phelps and Peters, *loc. cit.*). In this case there is a very sharp maximum in the adsorption at the iso-electric point of the acid. Although there can be little doubt that the amino-acids in the bulk phase of their solutions exist almost exclusively in the zwitterion form, it would seem that a possibility exists that in interfaces the equilibrium may be displaced in favour of the "classical" un-ionised form.

"A Method of Low-Pressure Ultra-Filtration," by S. J. Folley.—In the preparation of ultra-filtrates for quantitative study, there are certain objections to the use of metallic apparatus in which biological fluids are filtered through flat membranes. Contact of the filtrand with metal surfaces or rubber gaskets is undesirable, while the high pressures (1 or more atmospheres) which are often employed, as in the Bechold type of ultra-filtration apparatus, lead to results which are not applicable to conditions obtaining in living systems. For many quantitative purposes use of an apparatus employing collodion sacs is to be preferred.

A battery of six all-glass ultra-filtration units is used for estimation of ultra-filtrable serum calcium. The collodion sacs are tied to filtration heads which fit into receiving tubes by means of standard ground-glass joints. Once fixed, the sacs can be used repeatedly, being washed and refilled *in situ*. A special device is used to exert a constant excess pressure of 150 mm. Hg on the sac contents, precautions being taken to exclude evaporation of the filtrates.

Collodion sacs are prepared by a standard method. They are cast and dried in a closed vessel, through which, during the latter process, a stream of dry air is drawn at a known rate. The permeability of the membranes can be varied by changing the velocity of the air stream and/or the drying time.

"A New Variable Factor in Butter Fat," by R. G. Booth, W. J. Dann, S. K. Kon, and T. Moore.—The blue colour given by the non-saponifiable residue of butter fat is much greater (2—10 times) than the value that would be calculated from data obtained on the untreated fat. The substance causing inhibition in the untreated fat, which also produces inhibition in vitamin-*A* added from an external source (B.D.H. concentrate) is subject to seasonal variation, being present in greatest amount when the cows have access to pasture or green fodder. The inhibitor is light sensitive, and is rapidly destroyed by mercury arc irradiation. Two other variable properties of butter fat have been observed to undergo seasonal variation (1) the intensity of absorption by the free acids at 230 μ ($E^{1\%}_{1\,cm.}$ winter 10.→ summer 25). (2) The rate of brown colour formation by the free acids when treated with the antimony trichloride (3—4 times greater in summer samples). The relation of these properties to inhibitory power in the $SbCl_3$ reaction is still uncertain. As a practical conclusion, the present work indicates that the blue values given by untreated butter fat are valueless as a guide to its vitamin-*A* activity. The blue value given by the non-saponifiable residue should afford a rough indication of the biological activity, but even in this case we have still to allow for the presence of variable amounts of carotene, the biological activity of which per blue unit may be much greater than vitamin-*A*. To obtain a more accurate indication of the activity of a sample of butter fat by colorimetric methods it would be necessary to combine its carotene content as indicated by the yellow colour with the blue colour given by the non-saponifiable residue of the butter previously decolorised by treatment with charcoal.

"Carbonic Anhydrase," by N. U. Meldrum and F. J. W. Roughton.—I. The authors have isolated a catalyst from blood—carbonic anhydrase—which accelerates the slow reactions

$$H_2CO_3 \rightleftharpoons H_2O + CO_2$$
$$HCO_3' \rightleftharpoons OH' + CO_2$$

and demonstrated the participation of the bicarbonate ion in CO_2 carriage in blood.

II. They have found CO_2 to combine with free $-NH_2$ (not free NH_3^+) to a greater extent in reduced than in oxyhæmoglobin. This mechanism, which is independent of the enzyme may account for 25% of the CO_2 expired. The catalyst can very readily be separated from hæmoglobin by the combined action of alcohol and chloroform. The action of certain inhibitors has been studied. The enzyme is inhibited by HCN, H_2S, NaN_3 at 10^{-3} M conc. and by CO. It thus has the properties of the so-called hæmatin catalysts, peroxidase, catalase and Atmungsferment. Yet it contains no hæmatin.

Cu, Ag, Au, Zn (Ca) Hg are powerful inhibitors. In this respect carbonic anhydrase resembles xanthine oxidase, papain, saccharase, catalase, etc., and the action of these metals may be an (as yet empirical) principle of enzyme chemistry. There is an antagonism between Ag and HCN.

"The Isolation of Sapotoxins from the Tubers of Tannia, *Xanthosoma atrovirens*, and some Notes on their Toxic Effects," by A. Clark and R. B. Waters. Waters succeeded in isolating from these tubers two sapotoxins, A and B, having similar effects. 0·1 mg. of A kills a 60-g. rat instantaneously from cardiac and respiratory paralysis. 0·05 mg. kills in from 5 to 20 minutes. The blood sugar is high, the liver glycogen low. Intestinal peristalsis is diminished or absent. The urine is albuminous, and the kidneys show destructive effects similar to those produced by injection of uranium nitrate.

One in 20,000 normal saline solution of A or B hæmolyse blood and reduce the liberated hæmoglobin to hæmatoporphyrin or beyond. Rats fed on the raw tubers or on sterol-free normal diet in which 1% of crude extract containing A or B is incorporated die in 2—3 days in gradually increasing lethargy, from which they can be ronsed for a short period by intravenous injection of adrenalin. The blood sugar of these animals is low, liver glycogen almost absent, and liver, kidneys and supra-renals are dark. The cæcum is greatly distended; the stomach and intestines contain blood; the kidneys are inflamed and there is much blood pigment in the liver and supra-renals, and a little in the kidneys.

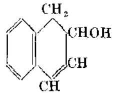
"Observations on the Metabolism of Naphthalene in Rabbits," by M. C. Bourne and L. Young. In men and dogs naphthalene is oxidized to naphthol and excreted in the urine in the form of naphthol-glycuronate or ethereal sulphate. In the rabbit, we find that a considerable portion of the dose is excreted in the form of some compound which readily yields naphthalene on treatment with acid.

The presence of this substance was demonstrated by the following experiment: The urine of a rabbit, collected during the 24 hours following a two-gram dose of naphthalene, was made acid with HCl and warmed on the water-bath. Within a short time colourless crystals began to collect on the cool parts of the flask. This material, after purification, was identified as naphthalene, since it had a melting point of 79·5°, a mixed melting point of 79·5°, and gave a picrate melting at 149·5°. It was not present in the urine (which is alkaline when excreted) as free naphthalene, but appeared only when the urine was made acid; and it must therefore have been derived from some compound by the action of mineral acid.

The naphthalene-producing compound is very soluble in water. It is not destroyed by evaporating the urine to dryness, and can be extracted from the residue by methyl alcohol; it is insoluble in acetone, ethyl acetate, ether and the common fat solvents.

No material sufficiently pure to permit the application of specific tests has been obtained.

It is suggested that the naphthalene-producing compound might be 1—2 dihydro-β-naphthol, a substance which is stable to alkali and readily converted to naphthalene by acid.



"Some Observations on the Nature and Properties of 'Bios,'" by R. L. Edwards. A "bios" concentrate was prepared by extracting brewer's yeast with boiling water and precipitating inactive material with lead acetate, basic lead acetate, phosphotungstic acid, and baryta in 80% alcohol. This concentrate gave satisfactory growth with nine strains of yeast in doses of 0·05 mg./c.c. to 0·2 mg./c.c. The inoculum used in testing was 50—100 cells/c.c. and 1—5 million cells/c.c. were produced in 2—4 days.

The concentrate contained no detectable amount of inositol, and pure inositol showed no effect on any of the strains tested, alone or in conjunction with the active concentrate. Thallium chloride had no effect on any of the strains tested. Ether-alcohol extraction of the above concentrate at p_H 2·5 gave a preparation active in doses of 0·01—0·04 mg./c.c. Pure ether extraction from solution or from the dry material was ineffective. The active concentrate gave the following reactions:—Molisch, Pauly, ninhydrin, reduced Fehling's and cold potassium permanganate: negative-biuret, Millon's glyoxylic acid.

On electrodialysis in a three compartment cell, using parchment membranes, the activity migrated to the centre, p_H 3—5. No indication of supplementary factors was obtained.

Aspergillus versicolor, grown on Czapek-Dox medium with various sources of carbon, synthesized from hexoses, pentoses, inositol and stearic acid, material active for strains 2190 and Gebrüde Mayer. From sodium acetate the mould produced a factor active for Gebrüde Mayer but not for 2190.

A preparation of Dr. Knight's which stimulates for growth of B. sporogenes was also active for Gebrüde Mayer but not for 2190.

These results seem to establish the existence of growth factors specific for different strains of yeast.

Yeast grown on Reader's medium with sufficient bios gave a higher fermentation rate than when grown on wort. Both gave lower figures than commercial brewer's yeast. The value was unaffected by treating the yeast crops with wort or phosphate solution. The rate was increased by addition of barium filtrate but not by the ether alcohol extract. The effect is therefore not caused by bios, but presumably by the Z factor.

"Investigation of Vitamin-B_2." By M. White. Liver is a convenient source of the vitamin. An aqueous extract of minced tissue is freed from coagulable protein at 80° C. and p_H 5. A great concentration can be effected by precipitations involving basic lead acetate and mercuric acetate. After adsorption of impurities by charcoal from glacial acetic acid solution the vitamin may be further purified by precipitations with alcohol of different concentrations. The final product is active in day doses of 0·1–0·5 mgm. when fed to B_2 deficient rats.

The vitamin becomes more sensitive to alkali and heat with purification. It is readily oxidized by H_2O_2 and HNO_3, with loss of activity, but unaffected by reduction. Fuller's earth and various charcoals adsorb the vitamin readily but benzoic acid, sulphur and silica gel are poor adsorbents. Enzymes do not attack it nor can it be esterified or acetylated. Formaldehyde treatment does not diminish its activity. It is involatile in steam or glycerine and is not sublimed in low vacuum at 100° C. Electrodialysis shows no migration. Filtration through graded membranes sets an upper limit of 700 to the molecular weight.

"Conversion of Carotene into Vitamin-*A* in the Animal Body," by R. J. Macwalter and J. C. Drummond. Further studies on the conversion of carotene into vitamin-*A* have been made using rabbits as typical of species accustomed to foods containing carotene and no vitamin-*A*. The estimations were carried out spectroscopically using the intensity of absorption of 3280 Å as a measure of the concentration of vitamin-*A*.

A preliminary investigation showed that the distribution of vitamin in the liver is not uniform and no correlation between the fat and vitamin concentration of the separate lobes was observed.

Experiments on the anaesthetized animal consisted in removing aseptically a small portion of the left anterior lobe for control purposes. A sterile isotonic suspension of carotene (approx. 1 mg.) was injected into the portal circulation and the animal allowed to recover. After varying periods the concentration of vitamin-*A* and of carotene in the basal portion of the partially-excised lobe, and in the residual liver were determined. No increase in vitamin-*A* was observed until 7 days after the injection. This was accompanied by an increase in weight. As much as 75% of the carotene was recovered.

The livers of rabbits which had received an injection of carotene suspension directly into the portal vein and which were subsequently removed aseptically and incubated in buffered solution at 37° C. did not form any appreciable amount of vitamin-*A* in 48 hours. The residual vitamin-*A* in the livers of rats which had received supplements of 20 γ of β Carotene per day for 4 weeks was considerably greater than in a similar series receiving α Carotene. Incubation of rat liver with carotene buffered at p_H 7·3 yielded no positive results. The caecum contents of rats were used to inoculate carotene suspensions. No vitamin-*A* was produced by incubation of these solutions.

These results confirm the earlier conclusion that the conversion of carotene into vitamin-*A* in the animal body is relatively slow and that it is far from being quantitative. There is some evidence of the formation in the inoculation experiments of a derivative of carotene absorbing strongly at 3280 Å but which may not be vitamin-*A*.

"The Interdependence of the Vitamins in their Growth-promoting Activity," by K. H. Coward. Evidence was given that the responses shown by rats to different doses of one vitamin are influenced by the amount of another vitamin present in the basal diet or in the substance tested. The influence is felt not only in the tests of the higher doses but in those of lower doses also. Thus the curves of response obtaining by giving the same series of doses of vitamin *D* but with basal diets containing different amounts of vitamin-*A* do not coincide at any point. The greater the amount of vitamin-*A* in the basal diet, the greater is the response to a given dose of vitamin-*D*. Similar relationships were shown for the *B* vitamins (B_1 and probably B_2) and for two samples of casein (though there is no clear evidence yet that the difference between the two caseins is due to the presence or absence of a vitamin).

"Further Observations on the Action of Proteolytic Enzymes on the Oxytocic Hormone of the Pituitary Gland," by J. M. Gulland and T. F. Macrae. The enzyme present in preparations of yeast dipeptidase, yeast proteinase and papain, which destroys the oxytocic hormone, is not Grassmann's prolinepeptidase. (*Z. physiol. Chem.*, 1932, **210**, 1.)

Trypsin preparations destroy the hormone, but the inactivation is caused by an enzyme which is not identical with the gelatine-splitting enzyme.

"The Action of Selenium Dioxide on Sterols and Bile Acids," by R. K. Callow and O. Rosenheim. The use of selenium dioxide as an oxidizing agent for organic compounds (Riley *et al*, 1932) has been extended to sterols and bile acids. A preliminary examination of the behaviour of about fifty compounds of this group with selenium dioxide shows that there are characteristic differences in reactivity in 90% alcohol, although the majority of the unsaturated compounds react in acetic acid at 100°. Ergosterol and its irradiation-products, derivatives of ergosterol containing an ethylenic linking resistant to catalytic hydrogenation, and the analogous *apo*cholic acid, are distinguished by their ready reactivity. In the cases so far investigated in detail, the product is not a ketone, as would have been expected by analogy with the reactions of simpler compounds, but either dehydrogenation occurs with the formation of a more unsaturated compound, or an oxide is formed. Ergosterol yields dehydroergosterol. *apo*Cholic acid

yields dihydroxycholadienic acid. Dihydroergosterol yields the oxide, accompanied by some ergosterol-*D*. Dihydroergosterol oxide is converted by a trace of acid into ergosterol-B_3, a reaction which can be interpreted as the result of the formation of a di-tertiary glycol followed by spontaneous dehydration to yield a compound with two conjugated ethylenic linkings in the same ring.

CORRESPONDENCE

PHOSPHORIC ANHYDRIDE AS DRYING AGENT

In reference to the lamentable publication of a paper on the oxidation of carbonyl sulphide, in the February number of the JOURNAL of the Chemical Society, I should like to point out that it is no kindness to the authors that it should have been allowed to appear. A well-known chemist reading a paper of his own of thirty years back, exclaimed, "I never thought I could ever have written such damned good stuff." What will the three authors themselves say if they read this paper thirty years hence?

The authors have summed up their lack of care in one paragraph. "O_2 was taken from a cylinder and dried by P_2O_5; it gave the same results as O_2 obtained by heating $KMnO_4$. The P_2O_5 was not specially purified. *It has been suggested that traces of phosphines, thereby* introduced, vitiate the results. This is very improbable, for the phenomena with COS fall into line with those of CS_2, and if phosphines were present, very much lower ignition temps. would be noticed. Moreover, this objection would cast doubt on many of the experiments on reaction kinetics during the last few years."

The last sentence is apparently a sly hit at their tutor. For reactions such as the one studied, the utmost care attainable is necessary in obtaining pure materials. Water vapour, in traces, is not the only catalyst which affects the course of a reaction. Cylinder oxygen is very useful in increasing the temperature of a blow-pipe flame, but, owing to the impurities it contains, it is utterly inadmissible for delicate quantitative operations. Oxygen from potassium permanganate, which the authors seem to think ideal, nearly always contains chlorine.

It is not wholly the fault of the young authors that such careless work is being done. They want in Oxford, working on physical chemistry, a man like Vernon Harcourt, whose meticulous care for accuracy in chemical work did so much for an earlier generation.

There is another cause which, in my opinion, is at the root of the trouble. No man can get a class in Honours in the Final Examination without a year's research work. The candidates pass a qualifying examination at the end of three years, and no matter what their aptitudes or dispositions may be, have to produce a year's (twenty-four weeks') research work before they can get an Honours degree. What this means to the harassed tutor one can easily imagine. He has, each year, to find six or eight problems which can be trusted to give a result in twenty-four weeks! He then has to supervise the working out of the problems by men with very little practical training, who are doing research against time. Those of us who have had experience in teaching, know that not more than one student in a hundred is a "born researcher," but, in Oxford, every honours student must become an investigator. Our own research students in London, who are picked men, often fail to produce results worth publishing in two years of 40 weeks each.

The haphazard and indifferent results lately published from some Oxford laboratories are largely due to the tutor having too many men to look after, some of poor calibre, and his not having sufficient leisure to do his own work properly.

I am, etc.,
H. B. BAKER

Imperial College, S.W.7
Mar. 18, 1933

THE DISSOCIATION CONSTANTS OF ACIDS

SIR,—In a discussion at the Chemical Society on March 2 (reported in your issue of March 10) I indicated the danger in employing the dissociation constants of acids as a measure of the tendencies of the molecules to lose protons. In a written contribution to the discussion Dr. Burkhardt has pointed out that I quoted as an example *o*-nitrobenzoic acid, and he suggests that "the notoriously complex influence of ortho groups on dissociation constants" vitiates my conclusions.

It was of course impossible for me to give full details in the discussion, and I certainly chose a striking example in order to emphasize my point, but an inspection of the data shows that ortho-substituted acids are by no means abnormal in the variation of their dissociation constants with the solvent. This is shown by the following table in which are given the dissociation constants of a few acids relative to benzoic acid in water and in ethyl alcohol:

	Water	Ethyl alcohol
Benzoic acid	1	1
Phenylacetic acid	0·91	1·23
o-Nitrobenzoic acid .	107	65·2
m-Nitrobenzoic acid	5·3	18·1
p-Nitrobenzoic acid .	6·3	20·0
2·4 Dinitrobenzoic acid .	580	1250
3·5 Dinitrobenzoic acid ..	26·7	220
Salicylic acid	16·7	59
Picric acid	$2·7 \times 10^3$	$2·2 \times 10^6$
Formic acid . . .	3·0	19·2

It is clear that, relative to benzoic acid, *o*-nitrobenzoic acid is more "normal" than the meta and para acids. It is also evident that even with acids of similar type no certain conclusions can be drawn when their dissociation constants differ by less than a factor of 10, while in comparing acids of different types, *e.g.*, benzoic and picric acids, differences of the order of 10^3 are scarcely significant.

The theoretical treatment of these important variations in the relative strengths of acids will appear elsewhere: my present purpose is merely to call attention to the uncertainty attaching to any generalization based on the dissociation constants of acids in water.

I am, Sir, etc.,
W. F. K. WYNNE-JONES

The University
Reading
Mar. 15, 1933

VISCOSITY OF COAL TARS AND PITCHES

SIR,—Your correspondents, Messrs. Traxler and Pittman, in their letter published in CHEMISTRY AND INDUSTRY, March 10, 1933, refer to the work carried out by the South Metropolitan Gas Company in association with the late Mr. H. Pickard in connexion with the viscosity of coal tars and pitches, and take us rather severely to task for omitting to give the origin and general characteristics of certain asphaltic bitumens which we examined.

We wish to point out that this work on asphaltic bitumen was only incidental to that on coal tar and pitch, and for this reason has received but brief mention in our publications. The asphaltic bitumens examined were derived from Mexican crude oil and included straight run bitumens, air-blown products and straight-run bitumens cut back with kerosene. Among the straight run bitumens was one giving a penetration of 65 (with a load of 100 g. on the needle for 5 sec. at 25° C.), and another a penetration of 5 with a softening point of 115° F. (ring and ball method). An air-blown asphalt examined gave a penetration of 12 and a softening point of 130° F. In all cases we found marked deviations from the laws of true viscous flow.

In the absence of any published results or details of the experimental methods adopted by Messrs. Traxler and Pittman, it is a little difficult for us to deal with their comments, but the lack of agreement between their results and our own certainly suggests that some caution is necessary before making any general statements regarding the "pseudo-viscous" properties of asphaltic bitumens. If your correspondents could provide us with some samples of the materials which they themselves have tested and found to be true fluids, we should welcome the opportunity of applying our own methods of test to these products.

I am, Sir, etc.,
H. STANIER

London, S.E.
Mar. 15, 1933

DANGER OF EXPLOSIONS

SIR,—During the distillation of some isopropyl ether in this Laboratory an explosion took place after most of the ether had been distilled off. The circumstances and effects were similar to such explosions as have been reported frequently with ethyl ether and attributed to the presence of peroxides.

This circumstance is reported to call attention to the possibility of trouble of this kind in the distillation of isopropyl ether.

I am, Sir, etc.,
R. ROBERTSON.
Government Chemist

Government Laboratory, W.C.2
Mar. 18, 1933

MORE EVIDENCE FOR ACTIVATED ADSORPTION

SIR,—On page 217 of the general discussion on "The Adsorption of Gases by Solids," published by the Faraday Society in January, 1932, you will find (if your copy is the same edition as is mine) the following statement by Prof. A. F. Benton, of the Cobb Chemical Laboratory, The University, Virginia.

". . . thermodynamically. In a number of systems large activated adsorptions have in fact been observed under conditions where compound formation is impossible. In addition to the case of oxygen–silver already referred to, further examples are found in the systems oxygen-gold and nickel–carbon monoxide. While . . ."

This quotation is obviously isolated from its context but no fair controversialist would deny the intention to couple the word *impossible* with the formation of a compound between nickel and carbon monoxide. On looking up the authority quoted, I find it in a paper by H. S. Taylor and Burns (J. Amer. Chem. Soc., **43**, 1273, 1921). The experimental data are derived from experiments on nickel and carbon monoxide at 184° C., which temperature is said to be outside the range of stability of nickel carbonyl.

Well, Mr. Editor, there is nothing like courage. In view of the working temperature of 200° C. quoted by Sexton and Primrose as the decomposer temperature used in the Mond carbonyl process for the manufacture of nickel, it would take more courage than is possessed by European chemists as a class to quote nickel and carbon monoxide as a typical case of non-compound formation. If the figures for decomposition *in vitro* are to be regarded as the same as the decomposition on surfaces entirely devoid of glass, then we are in for a neo-chemistry with a vengeance. The whole series of questions is begged. If the activated adsorptionists cannot do better than this they are in a poor way. However bent on winning one may be it seems as if the entry of cobs by Virginia out of Princeton for the Catalytic Stakes will only crowd the field, disillusion the punters, and enrich the bookies.

I am, Sir, etc.,
H. H. GRAY

Huddersfield
Mar. 20, 1932

PERSONAL AND OTHER ITEMS

We regret to record the death on March 17 of Prof. W. C. Unwin, F.R.S., the distinguished engineer, at the age of 94. He was active as a teacher for many years and was professor of engineering at the City and Guilds of London Technical Institute from 1884 to 1904, when he was made professor emeritus. He served as president of the Engineering Section of the British Association in 1892, president of the Institution of Civil Engineers in 1911, and president of the Institution of Mechanical Engineers in 1915—16. He was elected a Fellow of the Royal Society and served on the Council in 1894, and will be remembered as the author of many papers, the recipient of many engineering awards, and as one who took an important part in the first large-scale hydro-electric installation at Niagara Falls.

We regret to learn of the death on March 19 of Sir John Jackson, late Deputy Chief Inspector of Factories from 1920 to 1930. During the war he served as technical adviser of the trades section of the Ministry of National Service, and after the war was chairman of departmental committees dealing with factory conditions.

We regret to learn of the death on March 17 of Sir Edward Manville, the noted consulting engineer and industrialist. He was chairman of the Daimler Co. and was associated with many industrial undertakings

and had served as president of the Association of British Chambers of Commerce, vice-president of the Federation of British Industries, and president of the Society of Motor Manufacturers.

The Faculty Board of Geography and Geology of Cambridge University has recommended the establishment of the post of Assistant in Experimental Research in Crystallography in the Department of Mineralogy and Petrology. The Board also recommends the appointment of Mr. F. I. G. Rawlins, M.Sc., to the post for three years from April 1.

The General Electric Co. has announced the appointment of Mr. J. H. Farthing as a director of the company in place of the late Mr. H. V. Wynne Roberts. Mr. Farthing, who is the company's manager in the Lancashire and Yorkshire area, has been associated with the company since 1893.

The American Institute of Mining and Metallurgical Engineers has nominated Dr. Frederick M. Becket as president for the ensuing year. Dr. Becket is a Canadian and a graduate of McGill University. He has taken a notable part in the development of electro-metallurgy and has been associated with the Niagara Research Laboratories and its successor companies since 1903.

We regret to learn of the death recently of Dr. William Prendergast, M.D., at the age of 73. Dr. Prendergast was consulting expert on lead poisoning to the Home Office.

Mr. Arthur B. Winder, of Sheffield, has been appointed general manager of the English Steel Corporation, which is controlled by Vickers-Armstrongs, Ltd., and has also been elected to the board of the Corporation.

Joint Meeting at Liverpool

On Friday, April 7, the Chemical Engineering Group of the Society and the Institution of Chemical Engineers are to visit the Liverpool Section, and an attractive programme has been arranged for the day. In the afternoon a visit will be paid to the Central Electric Power Generating Station, Clarence Dock, and following tea in the University, Dr. F. J. Brislee will read a paper on "The Corner Metals of Electrical Distribution—Copper, Aluminium, and Lead." Following the meeting an informal dinner will be held at the University Club.

Chemical Society: Announcements

It was announced on March 16 that a letter had been received from the Union Internationale de Chimie stating that it is proposed to publish an International Table of Thermochemical Data, and that Dr. L. J. P. Keffler, The University, Liverpool, would therefore like to receive two copies of papers on thermochemistry published within the last five years.

The Institution of Petroleum Technologists invites Fellows to become members of the World Petroleum Congress to be held at the Imperial College, South Kensington, London, from July 19 to July 25, 1933. The membership fee is 10s.

The American Chemical Society invites foreign chemists to attend the general meeting at Chicago, U.S.A., from September 11 to 15, 1933, on the same terms as are accorded to members.

Extra-University Research

The Association of Scientific Workers is compiling a Handbook of Extra-University Research in Pure and Applied Science in which it is proposed to give data concerning commercial, endowed, and private research laboratories not included in the Universities' Year Book. Particulars are required of the types of research in progress, personnel engaged in research work, recent publications etc., and it is hoped that firms and others who are engaged in research work of a developmental and original character will communicate with the Association, 70, Victoria Street, London, S.W.1.

Legal News

Mr. J. E. Ferguson and Mr. S. Welch, managing director and director respectively of James Ferguson, Ltd. were summoned recently for corruptly making gifts to Mr. A. J. Buck, a research chemist of Bakelite, Ltd. and Mr. Buck was summoned for accepting the gifts. In the evidence it was stated that until 1928 Bakelite, Ltd. held the secret of a moulding powder and a monopoly in its production, but in that year James Ferguson, Ltd. placed a similar powder on the market. It was shown that Buck had disclosed a secret formula to Ferguson and Welch, although under agreement with Bakelite, Ltd. not to do so. The magistrate took into consideration the fact that the defendants were young men at the time of the offence, Ferguson being fined £300, Welch £150, and Buck £60, with the alternatives of three months', two months', and one month's imprisonment, respectively.

Award of Nichols Medal

The Nichols Medal of the New York Section of the American Chemical Society has been awarded to Dr. W. D. Bancroft, professor of physical chemistry at Cornell University, for his work on the application of colloid chemistry to physiological problems. The presentation was made on March 10 in New York, when Dr. Charles Parsons, secretary of the American Chemical Society, spoke on the medallist's achievements, and Prof. Bancroft delivered the medal address on "Protein Therapy."

World Petroleum Congress

A cordial invitation has been extended to members of this Society to become members of the World Petroleum Congress, which is to be held in July this year at the Imperial College, South Kensington (cf. CHEM. & IND., Feb. 17, p. 148). The Congress will be divided into geological, chemical and refining, engineering, and standardization sections. Arrangements for the Congress include visits to works of interest, a lecture at the Royal Institution, and a banquet at the Mayfair Hotel. Forms of application for membership can be obtained from the secretary of the Congress, Aldine House, Bedford Street, London, W.C.2.

Corrosion of Metals in Salt Solutions: Errata

The following corrections should be noted in connexion with Dr. Bengough's Jubilee Memorial Lecture: P. 195, col. 1, last par., for "Dr. Friend" read "the Committee for whom Dr. Friend was working."

P. 236, col. 2, line 14, the word "more" should be substituted for the word "most."

COMPANY NEWS

IMPERIAL CHEMICAL INDUSTRIES, LTD.

The gross income of Imperial Chemical Industries during 1932 was £6,415,123 as compared with £1,668,685 in 1931. As in last year, £1,000,000 has been placed to obsolescence and depreciation fund, and income tax absorbs £686,351, leaving a net profit of £1,729,072. This is an increase of £1,320,782 compared with last year, and £255,680 above the figure for 1930, when only £500,000 was *placed to* obsolescence and income tax absorbed only £156,365.

With £516,825 brought in from 1931 there is a total balance available of £5,245,897. Of this, £500,000 is placed to general reserve, £1,586,751 is absorbed in preference dividend and £1,089,740 in ordinary interim (2½%) dividend paid last December. The directors have now recommended a final ordinary dividend of 3½% less tax. This brings the total dividend to 6% for the year, which is 1½% better than last year, and a return to the level of 1930. The final dividend is payable on June 1.

Following the announcement of the year's financial results, employees of the combine are to have restored the wage reductions which were made in June, 1931. This was five-eighths of a penny per hour for male workers, and 5% in the case of men on piecework. The number of employees affected is 25,000.

BRITISH ALUMINIUM CO., LTD.

The company reports an available profit for 1932 of £162,031, which is a slight increase on the profit for 1931. £50,000 has been placed to depreciation reserve and £10,000 to staff fund, and the directors recommend a dividend of 5% on the ordinary shares, leaving £51,979 to be carried forward.

VICKERS, LTD.

The directors of this iron, steel, and engineering combine have recommended a dividend for 1932 on the ordinary shares of 4% less tax, as against 5% last year. The dividend is payable on April 1.

INTERNATIONAL PAINT AND COMPOSITIONS CO.

The net profit of the company for 1932 was £102,362, an increase of £12,000 compared with 1931. The ordinary dividend is maintained as last year at 9%.

SALT UNION

The report of the Salt Union for 1932 shows a profit of £206,831, as compared with £193,803 last year. The ordinary dividend is again 9%, and £20,000 has been placed to contingencies, £15,867 being carried forward.

UNITED GLASS BOTTLE MANUFACTURERS

The trading profit of the company during 1932 was £202,281, as compared with £182,354 for 1931. The yield from investments was substantially lower than that for 1931, which included a cash bonus of £16,676, and after deduction of income tax the net profit was £114,140, as against £118,455 in 1931. The allocation to general reserve is £10,000 higher than last year, being £35,000. Total dividend, as previously announced, is again 7½%.

MARKET REPORT

This Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

The following alterations in prices are reported since the publication of the last Market Report (cf. CHEM. & IND., Mar. 3, 1933, p. 189).

GENERAL HEAVY CHEMICALS

Nickel Sulphate.—£52 per ton d/d.
Nickel Ammon. Sulphate.—£52 per ton d/d.

PHARMACEUTICAL AND PHOTOGRAPHIC MATERIALS

Iron Quinine Citrate, B.P.—9¼d.—9¾d. per oz., according to quantity.
Quinine Sulphate.—1s. 10d. per oz., for 100-oz. tins, tins free.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Argentina:* Tinplate (421). *Canada:* Battery chemicals, including ammonium chloride and accumulator acid (389). *Cyprus:* Paper (394). *Finland:* Industrial chemicals (405). *France:* Pig iron, iron and steel ingots, tinplate, zinc, and nickel (407). *Holland:* Steel and metal manufactures (411). *Spain:* High-class synthetic and natural oils, edible and fat soluble dyes (413).

Import Duties Advisory Committee

The Import Duties Advisory Committee has given notice of applications for an increase in the import duty on iron or steel kegs, drums and barrels, and for drawback under Section 9 of the Finance Act, 1932, in the case of sporting cartridges in respect of the cartridge cases and powder used in their manufacture.

Representations with regard to these applications should be addressed to the Secretary, Import Duties Advisory Committee, Caxton House, Tothill Street, London, S.W.1, not later than April 3.

PUBLICATIONS RECEIVED

ANNUAL REPORTS ON THE PROGRESS OF CHEMISTRY FOR 1932. Issued by the Chemical Society. Vol. XXIX. Pp. xi + 344. London: Chemical Society, 1933. 10s. 6d.

REPORT OF THE MEDICAL RESEARCH COUNCIL FOR THE YEAR 1931—32. Committee of the Privy Council for Medical Research. Pp. 140. London: H.M. Stationery Office, 1933. 2s.

SCHOOLS, 1933. 10th ed. Pp. 740. London: Truman & Knightley, Ltd., 1933. 2s. 6d.

BESONDERE VERFAHREN ZUR HERSTELLUNG VON SEIFE. By Dr. A. van der Werth. Pp. 56. Berlin: A. Industrie-Verlag, 1933. 5 rm.

REPORT OF THE FUEL RESEARCH BOARD FOR THE YEAR ENDED MARCH, 1932. Department of Scientific and Industrial Research. Pp. viii + 96. London: H.M. Stationery Office, 1933. 2s.

SECONDARY ALUMINIUM. By R. J. Anderson, D.Sc. Pp. xv + 563. London: Chapman & Hall, Ltd., 1933. 42s.